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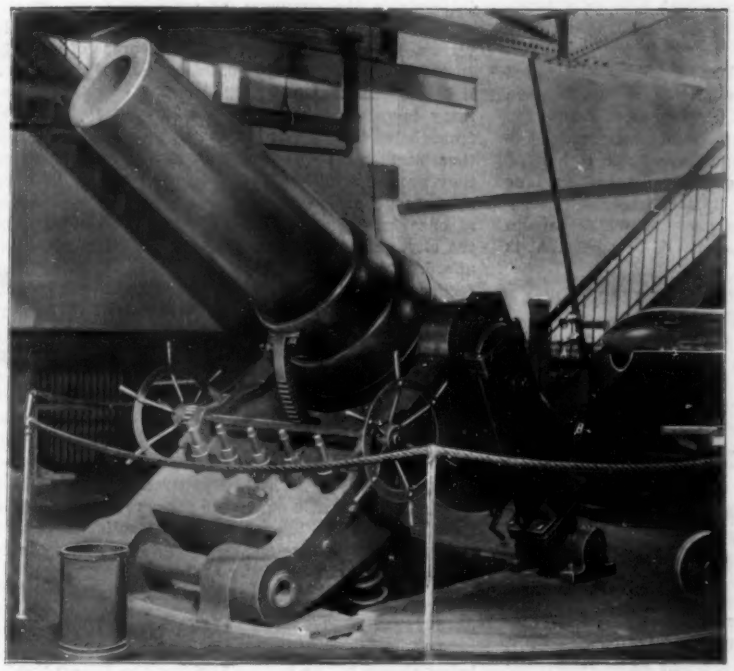
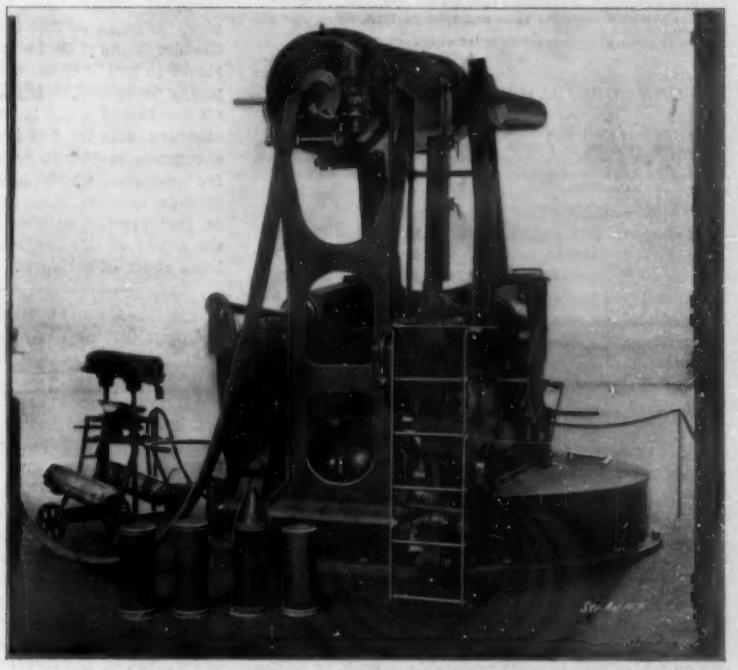
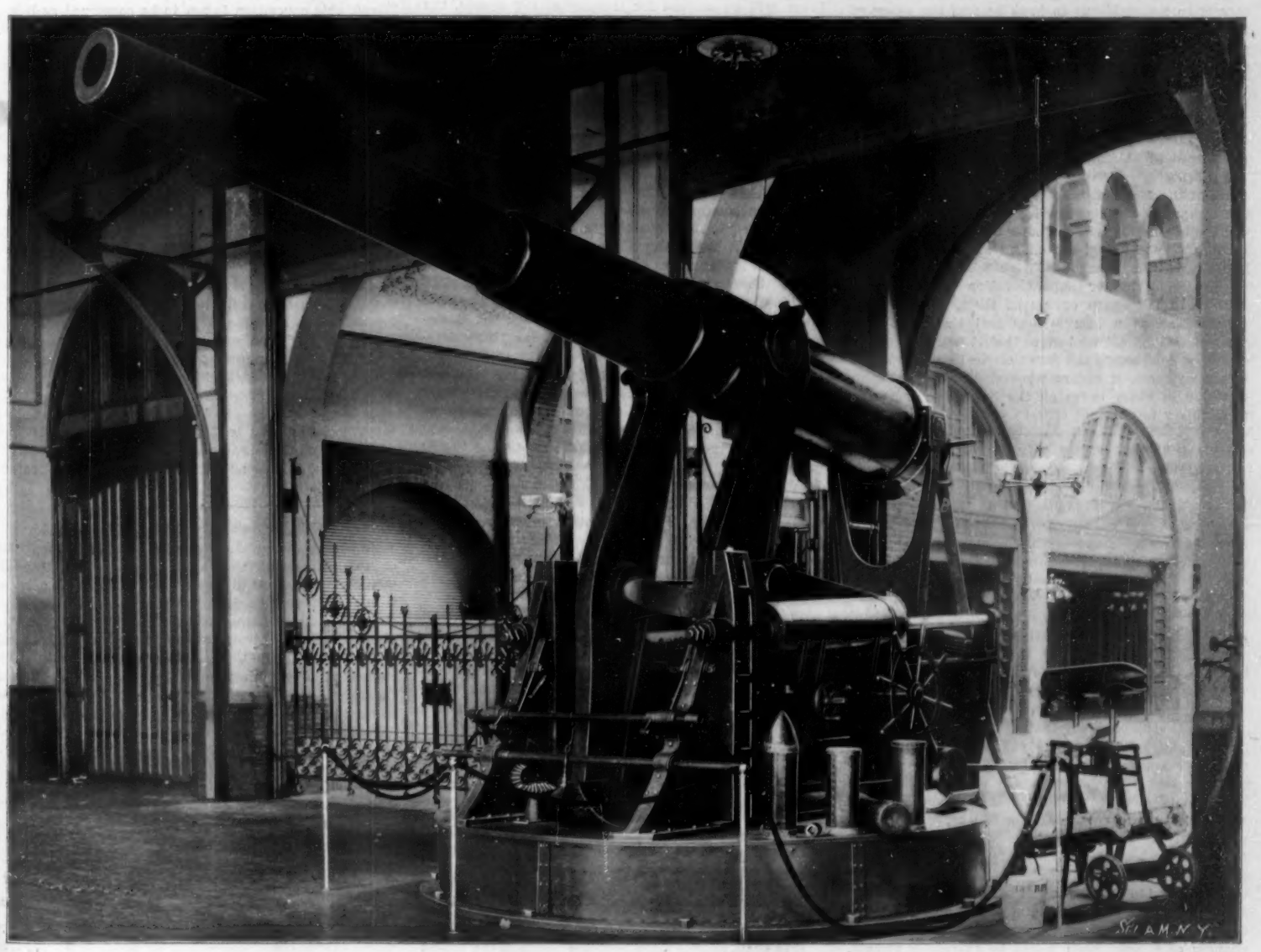


The 12-Inch Mortar.



Rear View of 8-Inch Gun Showing Compressed-Air Attachment and Dummy Shell.



Working Model of 8-Inch Gun in 13th Regiment Armory, Brooklyn.

SHELL PRACTICE WITH MODERN COAST-DEFENSE GUNS IN A CITY ARMORY.—[See page 222.]

SCIENTIFIC AMERICAN
ESTABLISHED 1845

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NEW YORK, SATURDAY, MARCH 29, 1902.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

SPEED ON THE ELEVATED RAILROAD CURVES.

We believe it may be said, without fear of contradiction, that the sharpest curves on any broad-gage steam railroad system in this or any other country are to be found on the Elevated Railroads in this city. The sharpest on the road are to be found on the Sixth Avenue line, one at the intersection of Church and Murray Streets, and the other at the intersection of West Third Street and Sixth Avenue. Until the past few months, the speed of trains in passing around these curves has been reduced to a limit which gives a reasonable margin of safety against accident; but of late there has been an evident acceleration, and some of the trains take the curves with such velocity that, in spite of the considerable super-elevation of the outer rail, the cars are thrown heavily onto the bearing plates of the trucks, and actually at times have a distinct inclination to the outside instead of to the inside, as they should have, of the curve. The curve at West Third Street and Sixth Avenue is the one on which this is most noticeable, especially in the case of the uptown evening trains; the lurching of the cars is so noticeable as to have become the object of remark among old-time travelers on the road. At the speed with which the curves are being taken, the strains on the wheel flanges are simply enormous and, of course, the tendency of the flange to climb the rail is proportionally increased. Should a flange give way or a wheel mount the rail, the present wooden guard rails would, on curves of such short radius, be of little avail in holding the engine upon the structure.

We draw attention to this matter particularly because of the fact that with the completion of the electric equipment, a faster running speed is contemplated, and the temptation will be rather to increase the speed than to reduce it. If the curves are to be taken at high speed, the element of risk will be eliminated by giving a higher super-elevation to the outer rail. On such sharp curves as these, excessive super-elevation is a less serious evil than too little super-elevation, and we believe that it would be an excellent policy, before the fast electrical train schedule is put in force, if orders were given for the super-elevation of every curve on the line to be increased from thirty to fifty per cent.

MOVING SIDEWALK FOR THE BROOKLYN BRIDGE.

The moving sidewalk, a device which came into public notice at the World's Fair, Chicago, is proposed by Bridge Commissioner Lindenthal as the best remedy for the congested condition of travel across the Brooklyn Bridge. He proposes that four lines of moving platforms be arranged, running at speeds of 2½, 5, 7½ and 10 miles an hour, respectively. Of the four platforms, only the one moving at ten miles an hour would cross the bridge; the other three would extend merely around the loops at the two terminals, and would be installed simply to assist passengers in boarding the ten-mile platform, which, by the way, would be provided with seats similar to those of the moving platform at Chicago.

While nobody can deny that for passenger traffic the moving platform has a vastly greater capacity than any other known system, there is always the serious objection that a breakdown in any portion of the platform would mean the stoppage of the whole system until repairs could be made. For this reason we think that until the moving platform has been thoroughly tested under heavy conditions of traffic, it would be inexpedient to place one on such an important thoroughfare as the Brooklyn Bridge. At the same time, we do not doubt that by careful design and workmanship it could be made so mechanically perfect that the chances of a breakdown would be extremely remote. Under Lindenthal's scheme, a covered glass shelter would extend over the ten-mile platform, affording protection to passengers throughout the whole trip.

FAULTY PIPE THREADS.

Our esteemed contemporary The Locomotive draws attention in a characteristic article to the necessity for exercising great care in the cutting of threads on steam, water and gas pipes. Although piping as turned out from the mills of the manufacturer is threaded, or supposed to be threaded, according to a national standard, when it comes to be cut into commercial lengths in the installation of new systems of piping, or in repairing old systems, the standard proportions of thread are too seldom followed. The shop-cut threads are often so faulty that it is impossible to make a good joint with the standard fittings which they have to enter; hence the number of failures that occur at threaded joints. Thus, the standard calls, in a 4-inch pipe, for eight perfect threads, the total length cut by the die being 1.80 inches. Yet it is common experience to find that the total length of thread on 4-inch piping is only 1.25 inches, and, indeed, this is often all the thread there is on a 6-inch pipe, although the standard calls for 2.01 inches. As a consequence, it is a common matter to find pipe connections to boilers, for instance, which have only two, three or four threads properly made up. It is claimed, and justly so, that practice such as this shows an indifference to the safety of life and the security of property that is little short of criminal.

A NOVEL TURBINE DESTROYER.

A new turbine destroyer, the "Velox," has recently been launched by the British government from a Tyne shipbuilding yard. She is similar in dimensions to the ill-fated "Viper" and "Cobra;" but special attention has been given to the question of structural strength, with a view to preventing any such disaster as happened to those two craft. The novel feature of this vessel is that, in addition to the compound turbine engines which comprise the main source of power, a small set of ordinary reciprocating, triple-expansion engines is introduced. The object of this arrangement is to get around the difficulty of using the turbine engines when traveling at cruising speed, for which they are extremely uneconomical. The turbine shows its best economy when it is working up to full power, and in the new destroyer the small reciprocating engines, which are on the same shaft as the turbines, will be utilized for cruising at low speeds, the exhaust steam of these engines passing through the turbines, and finally into the condensers. When the higher speeds are required, steam will be admitted direct from the boilers to both the reciprocating engines and the turbines. When the propellers have reached a velocity that would be dangerous to the reciprocating engines, the latter will be thrown out of gear, and the turbines independently operated.

ARMOR PLATE FOR THE RUSSIAN GOVERNMENT.

The construction of the battleship "Retvizan" and the cruiser "Variag" for the Russian government by an American shipbuilding yard, the armor for which ships was made by the Bethlehem Steel Company, has led to the placing of other Russian orders for plate in this country. A striking evidence of this was seen last week in a train of eighteen cars which left Homestead on express orders for New York, carrying thirty-six plates for the first-class battleships "Borodino" and "Ariel," which are now building at the Imperial yards at St. Petersburg. The consignment represented six months' work at the armor-plate department at Homestead. In view of the fact that the armor plate required for the new warships for the United States navy is more than sufficient to keep the Bethlehem Steel Works and the Carnegie Works continuously occupied, it is evident that there is a call for other armor-plate factories in addition to the two above named. We understand from the last report of the Naval Bureau that a third firm will shortly be in a position to turn out Krupp armor; but if we are to furnish the armor for our own navy and also supply foreign governments on the scale of this recent shipment, it is evident that there will soon be a demand for a fourth armor-plate-making establishment. The industry is an extremely profitable one, even at the reduced price at which plate is now being furnished. Indeed, we do not know of any industrial enterprise in which capital could be invested on a large scale with a surer certainty of profitable returns. There is not the slightest indication of any slowing up in the rate of growth of the navies of the world, our own included; and if the United States navy is to increase in adequate proportion to the extension of our foreign trade (as it certainly should do), the demands of our navy alone will before long require double the amount of armor plate that is now being furnished annually by existing works.

FIRE INSPECTION OF HOTELS.

It is gratifying to learn that one result of the recent Park Avenue fire has been the awakening of proprietors of hotels in this city to the necessity of thorough fire inspection, the improvement of existing fire-fighting apparatus, and the installation of new protective devices designed to facilitate the escape of guests on the breaking out of a fire. The fact that the fire originated at the bottom of an elevator shaft, probably among some oil-soaked waste and refuse, and that, as it swept up through the shaft, it was intensified by the combustible material built into the shaft itself, has led to the conviction that elevator shafts, and all other vertical openings through the building should be most thoroughly fireproofed, and that the landings at the various floors should be provided with fireproof doors. A protective device, which the Superintendent of the Department of Buildings is strongly advocating as a preventive against disasters, is the provision, at stated intervals in the corridors, of swinging doors, whose object would be to confine the dense smoke which always accompanies fire, within limited areas of a hotel. In the recent fire, as, indeed, in the case of most fires, it is the dense and suffocating smoke that is the primary cause of much of the loss of life. People rush from their rooms into an atmosphere that either drives them back to the outer windows, or suffocates them as they grope for the stairways or other exits. This is a common-sense suggestion, which should be adopted at once in every hotel, at least of the older type, in the city. In view of the great protection they would afford, it is certain that hotel patrons would be perfectly willing to endure the slight inconvenience of passing one or two sets of such doors on their way through the corridors.

Yet another suggestion, which is both common sense and practicable, is that of constructing bridges across the interior courts, by which guests on each floor could make a short cut to the rear or front of the hotel, as the case might be, without having to pass through a great length of corridor. A time like the present, when the public has just received such a terrible object-lesson, is opportune for a revision of those laws which affect the fireproof construction of hotels and public buildings, and the provision and maintenance of proper fire-fighting apparatus.

OBJECTIONS TO THE PENNSYLVANIA TUNNEL BILL.

Although a considerable amount of opposition is being shown to the bill authorizing the Pennsylvania Railroad to construct a tunnel beneath Manhattan Island, this opposition is not to be construed as being directed against the tunnel scheme as such. Indeed, it is pretty safe to say that every interest that will be affected by the tunnel is disposed to view the scheme with unqualified approval. The most serious opposition to the bill comes from the Rapid Transit Commission, on the ground that it takes away from the Commission the power to supervise and regulate the construction and operation of tunnels in the way that was contemplated by the Rapid Transit Act. Moreover, it is claimed that while it grants a favorable franchise in perpetuity, the bill does not guarantee to the city an adequate compensation, and in its present form overrides the city charter which limits the granting of franchises to a period of twenty-five years. Furthermore, the bill fails to settle the amount of compensation to be paid to the city, making it purely discretional. If these points are well taken, they should certainly be sufficient to prevent the passage of the bill in its present form. The lavish gift of franchises by the authorities, in the earlier years of its history, has robbed the city treasury of profitable sources of revenue. The bill should be so amended as to protect the city without hampering the railroad company, and at the same time leave the Rapid Transit Commission supreme in the control of Rapid Transit in this city.

SAILING VESSELS IN THE SUEZ CANAL.

No sailing vessels have crossed the canal since 1874 or 1875, except during the time of the Turko-Russian war of 1877-78. At that time sailing vessels arrived from Calcutta with Indian troops; but for the last ten years no sea-going sailing vessel has crossed the canal. Sometimes trains of coal and materials, treated by the Suez Canal Company as sailing vessels, with the object of collecting the towing duties, have crossed the canal, but no sailing vessel engaged in high-sea navigation has crossed it within the period named. The absence of sailing vessels in the canal is explained by the difficulties of navigation in the Red Sea. The extraordinary number of sailing vessels lost in the Red Sea (which is full of dangerous reefs and shoals) during the years 1872-73 seems to have effectually discouraged further attempts. The officials of the Suez Canal Company believe that the construction of the canal, which was opened to navigation in 1869, has been an impetus to steam navigation throughout the world.

Telluride, Col., was the scene of a snowslide recently which overwhelmed the men at the shaft of the Liberty Bell Mine. Thirty men were lost in the slide and forty in a rescuing party who were swept down by a second slide.

THE HEAVENS IN APRIL, 1902.

BY HENRY NORRIS RUSSELL, PH D.

The evening skies still remain unadorned by any of the planets, and even the bright winter constellations are now disappearing in the west. Though the present is therefore a dull season for the amateur astronomer, it affords an excellent opportunity to see certain objects—we can hardly call them bodies—which, though belonging to our solar system, bear the same relation to the planets that the Milky Way does to the stars.

The most conspicuous of these objects is known as the zodiacal light. It can easily be seen on any clear evening when the moon is out of the way. As soon as the twilight has faded from the western sky, so that the Milky Way becomes visible, there appears a band of light, rising from the horizon near the point where the sun has set, and extending upward, with a considerable inclination toward the left. Its lower portions are fully as bright as the Milky Way, and of considerable breadth, but it grows narrower and fainter as it ascends, so that its general form is wedge-shaped. At the present season its top is lost in the Milky Way.

A similar phenomenon can be seen in the eastern sky before dawn.

Upon investigating the position of this light among the stars, it is found that its central line lies along the ecliptic, among the constellations of the Zodiac. It is for this reason that it is called the zodiacal light. Unlike the Milky Way, the zodiacal light does not remain in the same position among the stars. It moves around the ecliptic once a year, with the sun, so that it is always seen in the west after sunset, or in the east before sunrise. It is not, however, always equally conspicuous, at least in our northern latitudes. In spring the ecliptic rises steeply above the western horizon, and the evening zodiacal light is prominent. In the autumn, when the ecliptic makes but a small angle with the horizon, it is, for the most part, lost in the haze.

The zodiacal light is best visible in the morning just when it is least conspicuous in the evening, that is, in the late autumn.

Since it thus keeps pace with the sun, the zodiacal light is evidently connected in some way with the solar system. The generally accepted explanation of it is parallel with that which the telescope gives us for the Milky Way. Just as the latter is composed of multitudes of stars, too small to be separately seen, so the zodiacal light is supposed to be due to sunlight reflected from a multitude of small planets.

The separate stars which compose the Milky Way can be seen with the telescope; but this is not the case with the zodiacal light. The points of light whose aggregate produces the effect we see must in this case be much fainter, and much more numerous; such small bodies, in fact, that they are more akin to the meteoric stones which sometimes fall upon the earth than to the planets, or even the asteroids.

We may then say that the zodiacal light is sunlight reflected by a vast swarm of meteorites revolving about the sun. From the observed form of the light, it appears that this swarm has the form of a lens, with the sun at the center. Its denser parts do not extend outside the orbit of Venus, but the outer portions pass somewhat beyond the earth's orbit.

This is shown by the fact that, in clear air, the zodiacal light has been seen to extend clear across the sky, as a faint band. On this band, directly opposite the sun, appears a brighter spot, known as the Gegenschein, or countergiow, which has of late years been of considerable interest to astronomers. We hope to speak of it more fully next month.

THE HEAVENS.

At 9 P. M., on the 15th, Perseus, Taurus, Orion and Canis Major are near the western horizon, and will soon set. Auriga, Gemini and Canis Minor are above them. Ursa Major is in the zenith, and Leo on the meridian south of it, with Hydra below, and Virgo on the left. Bootes is well up in the east, with Corona Borealis and Hercules below and to the left. Vega has just risen in the northeast. Cepheus and Cassiopeia are below the pole, and Draco to the right of it.

THE PLANETS.

Mercury is morning star till the 28th, when he passes behind the sun and becomes an evening star. He cannot be seen except perhaps during the first few days of the month, when he rises about 40 minutes before the sun.

Venus is also morning star, rising about two hours before sunrise. Her elongation, or apparent distance from the sun, increases until the 25th, after which it slowly diminishes. On the 1st she appears telescopically as a broad crescent, and on the 25th as an exact half-moon. Her distance from us is rapidly increasing, and her light is in consequence diminishing.

Mars is morning star, but is too near the sun to be seen.

Jupiter is morning star in Capricornus, rising about 2:30 A. M. on the 15th.

Saturn is also morning star and rises about three-quarters of an hour earlier than Jupiter.

Uranus is morning star in Ophiuchus, and Neptune evening star in Gemini.

THE MOON.

New Moon occurs on the morning of the 8th, first quarter on the evening of the 14th, full moon on the afternoon of the 22d, and last quarter on that of the 30th. The moon is nearest us on the 10th, and farthest off on the 26th. She passes near Saturn on the 2d, Jupiter on the 3d, Venus on the 5th, Mercury on the 7th, Mars on the 8th, Neptune on the 13th, Uranus on the 26th, and Saturn again on the 29th.

Two eclipses occur during the month, but neither can be seen in this country. The first—a very small partial eclipse of the sun on the 8th—is only visible in the Arctic Ocean north of Alaska. The second—a total eclipse of the moon, on the 17th—is visible generally throughout Asia, and, all but the beginning, in Europe and Africa.

Princeton, N. J.

ELECTRICITY AND POWER DIRECT FROM HEAT.

BY JAMES ASHER.

There are several methods of obtaining electricity from heat without the use of any working fluid, such as steam or gas used in engines to drive dynamos.

The thermo-electric battery consists in a set of strips of either unlike metals, or of alloys whose alternate junctions are heated while their opposite junctions are cooled. Mr. Nicola Tesla once told the writer that it is utterly impossible to obtain an efficiency of more than 2 per cent from any thermo-electric battery. On another occasion he said that the low output of the thermo-electric battery is not its greatest defect, but the fact that the junctions of the metal become greatly impaired while in use. Mr. Henry Barringer Cox invented a battery in which he claims that the latter objection has been overcome. The elements during construction are melted together so that the alloys enter into intimate contact with each other.

Thermo-electric batteries might be directly heated by the rays of the sun. The battery might be supported on a frame inclined to face the solar rays and provided with an axle in order that it might always face the sun during the day. An automatic device might impart a slow rotation to the battery in a manner similar to that in large equatorial telescopes. The battery should have a glass roof similar to that of a hothouse. The roof should be quite close to the battery. The ends of the elements facing the sun should be coated with lampblack in order to secure great absorption of heat. The short, or light rays which enter the glass on reaching the elements of the battery would be transformed into long or heat rays. Such rays cannot escape through glass. The glass roof would act as a trap to the solar rays. Besides it would prevent the heat from being carried away from the battery by the wind. The running expense of such a thermo-electric battery would be nothing because the heat of the sun is free. About one horse power from the sun falls on every square yard of the earth. If a thermo-electric battery can transform even 2 per cent of the total energy into electricity it might be advisable in many cases to erect large solar thermo-electric batteries. It might be thought that there would be an advantage in using a smaller battery and many mirrors. But there is no advantage in maintaining one end of a thermo-electric battery at a temperature of more than 100 degrees higher than the other end. The lower ends of a solar thermo-electric battery would be cooled by the atmosphere and by radiation to the shaded earth below. The current of electricity could be conducted along a wire to a distance, and used to drive motors, and to charge storage batteries, in order to yield electric light. No attendant would be required.

A battery consisting of a set of iron cups containing carbons and caustic potash set over a furnace was invented by Mr. W. W. Jacques, of Massachusetts. The experiments caused many to believe that the time was near when electricity could be economically generated direct from the heat of burning fuel such as coal. Mr. C. J. Reed made a number of experiments with this invention which satisfied him that it is really a thermo-electric battery.

A pyromagnetic generator was invented in 1887 by Mr. Edison. It consists in a number of horizontal electromagnets whose poles point toward a vertical shaft. Facing the poles of the electromagnets are several compound vertical armature tubes of sheet iron only 1-200th of an inch in thickness. The upper ends of the tubes are fastened in a thick iron disk, while their lower ends are fastened in a similar disk. The iron disks serve as pole pieces for the electromagnets. The tubular armatures are wound with insulated copper wire which is led to a number of brushes which press against a commutator. Instead of having two brushes and many commutator bars this machine has many brushes and two commutator bars. The shaft bears a semicircular disk of fireclay at its lower end. During rotation, which is produced in any suitable manner, the fireclay disk successively screens the lower ends of the armature tubes from the upward passage of the hot furnace gases. During the passage of the hot furnace gases throughout the tubes these armature tubes lose magnetism, but while their lower ends are screened they become cool and gain magnetism from the electromagnets. The successive magnetizations and demagnetizations of the armature tubes cause currents of electricity to be generated in the wires which are wound on the tubes. The commutator aranges the curren's so that a direct or continuous current flows in the external circuit. The machine is mounted on a furnace which resembles a coal heating stove. Mr. Edison stated that a pyromagnetic generator weighing two or three tons would maintain thirty incandescent electric lamps each of 16 candle power.

A pyromagnetic motor was also invented by Mr. Edison. His largest machine weighs 1,500 pounds and yields about 3 horse power. Experiments showed that it is more economical of fuel than most other heat engines. This motor has a bipolar field magnet between whose pole pieces is an armature composed of a great many iron tubes each only about 1-200th of an inch in thickness. The armature has a vertical shaft. Two earthenware guides, one above the upper end and the other below the lower end of the armature, guide cold air into and out of about one-half of the armature tubes. A broad segment of the armature is being always cooled, while the two outer segments are always heated by the hot furnace gases which are blown through them. The cold air during its passage through the hot tubes while cooling them becomes elevated in temperature. This air is led below the burning coal. As a regenerative device this bears some resemblance to that used by Captain John Ericsson in his early hot-air engines. The two earthenware guides are stationary and they are set dissymmetrically in regard to the pole-pieces of the field magnets. The parts of the armature which are red-hot refuse to carry magnetic lines while the cooler parts carry them with great ease. Because of the dissymmetrical setting of the earthenware guide plates a distorted magnetic field is set up, which causes the armature to rotate with a speed of about one hundred and twenty revolutions a minute. This machine has serious faults. The excessively thin iron tubes soon become ruined by oxidation. Heat cannot be practically imparted to, and withdrawn from the tubes, so as to permit a greater speed than two revolutions a second. The vast number of tubes having small bore would soon become clogged with soot and ashes.

A pyromagnetic motor generator was invented and constructed by M. Menges, of The Hague, in Holland. It has a vertical shaft which bears a Gramme ring and a commutator. Fastened near the armature so as to rotate along with it is a corrugated sheet iron ring. A group of gas jets is set at about 45 degrees from the middle of one pole piece of the field magnet. Diametrically across the armature is a similar group of gas jets. These heat successive parts of the thin annular iron screen, while it and the armature rotate. The screen is cooled by two blasts of air diametrically across the armature from each other. The red-hot parts of the screen permit the passage of very few lines of force from the pole pieces of the field magnet. A distorted magnetic field is consequently set up which causes the rotation of the armature and the sheet iron screen which it carries. The iron ring of the armature, being wound with insulated copper wire, not only rotates and can give motive power direct, but electricity is generated in the wire of the armature. The current is led off by means of the commutator. Part of the current may excite the field magnet and part may supply electric lights. When motive power alone is required a permanent field magnet may be used. In this case neither wire on the ring, commutator nor brushes are required. This machine is a pyromagnetic motor. Menges' machines have two faults in common with those of Edison. The armature cannot revolve at a greater speed than 120 revolutions a minute and the rapid alternations of heating and cooling soon cause a failure of the thin annular screen. Pyromagnetic machines similar to those of Menges might be heated by the sun's rays reflected from a great many plane mirrors. This method would have an advantage over the solar steam engine such as the 10 horse power engine in use at Pasadena, Cal., because neither boiler, water nor engine would be required in order to generate currents of electricity.

The motive power in pyromagnetic machines is due to heat energy. Magnetism is introduced as a convenient means of transmitting energy from burning fuel to the armature of the machine.

It is said that Prof. Haeckel has consented to sit for a statue to Prof. Harrow Magnussen. The statue will probably be placed in the Zoological Gardens at Jena. One of Prof. Haeckel's friends some years ago gave 15,000 marks for this purpose.

A CURIOUS INSTANCE OF RE-INVENTION.

BY IRVING U. TOWNSEND, EXAMINER OF TEXTILES, PATENT OFFICE.

Ethnologists claim that primitive or savage man produced with his hands or with the rude implements at his disposal, as perfect specimens of workmanship, as can be made by civilized man of the present day, employing the same instrumentalities. In other words, the same ideas of mechanics seem to present themselves to man in all stages of his development, and are in his lower state of civilization embodied in as faultless construction as is now possible without the aid of machinery. This claim has been verified in what is known as the Wardwell cop of fibrous material, invented by Simon J. Wardwell, Jr., about 1891. In this cop each layer is composed of a large number of spiral windings. The coils of adjacent spirals are laid absolutely side by side without leaving any open space, upon a flangeless paper tube. As shown by the illustrations, the thread encircles the tube twice in passing from one end to the other (this constituting one spiral) and then is bent at an angle and returned to the starting point, lying throughout this course in contact with the portion of the thread just previously laid, the return spiral binding the first one about midway of its length with a V effect, clearly shown in the completed cop. For this reason the cop is often termed the V wind. Throughout the cop the thread is laid in a definite, final position, each spiral corresponding with every other spiral so far as the number of turns around the holder is concerned, and the angles of the different parts of the various coils to the axis of the tube are the same in all the layers, excepting for the changes incident to the increasing diameter of the cop. To lay adjacent spirals side by side, the thread when it reaches the end of its course in one direction is carried across the end of the spiral just previously laid in the same direction, so that when it is given a sharp bend to begin the return spiral (see right hand end of Fig. 2) it still lies side by side with it. To produce this effect there is imparted to the thread what is termed an increment of motion. By this it is meant that the thread guide is traversed at the end of its stroke in each direction a distance further equal to the width of the thread, or the thread guide may make a dwell, while the tube continues to rotate. The sharp bend at each end of each spiral prevents the undue accumulation of thread at the ends of the holder, so that the completed cop is truly cylindrical with flat ends. If the thread were laid in a long curve at the ends, as was the usual practice previously, the result would be a cop considerably narrower at the center than at the ends where the material is heaped up.

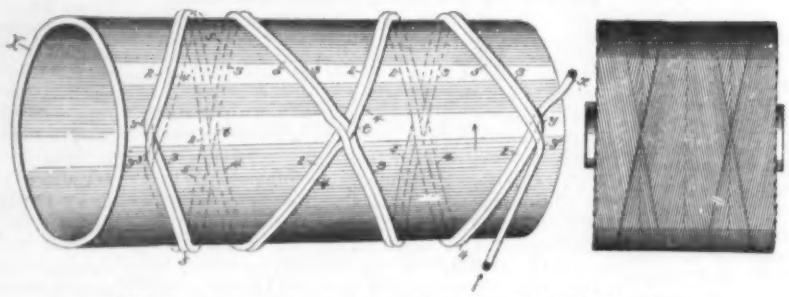
The Wardwell cop is the most compact cop that can be wound, and the definite and accurate winding, with the sharp return bends, permits the thread to be unwound down to the first spiral of the first layer with uniform tension. This is often very important, as where the cop is one of yarn for use in knitting machines.

For many years skilled inventors worked to improve cops of thread, and one wind after another was devised, the culmination being that just described, which it will be observed can be wound by hand with the exercise of great skill and patience, practically as well as by the most highly organized machine, though of course far more slowly. In fact, Wardwell so wound his first cop.

Suit was finally brought upon the patents for the cop and the method of winding it, and it was then accidentally discovered that in the National Museum at Washington and in the American Museum of Natural History at New York there are four large cops of rope or heavy cord, which in the language of the court are "identical in appearance" with the Wardwell cop. They present, at least superficially, every detail of the wind. There are, as the accompanying photographs show, the spirals and reverse spirals tying each other down intermediately between their ends, the sharp return bend at the end of each spiral, the absolute contact of successive spiral coils from end to end, the effect of the increment of motion, and the characteristic V wind. These cops had been for years in the possession of the museums, and it is certain that they were made by Fiji Islanders, undoubtedly by hand. In view of these cops the two patents were held to be invalid and this holding was sustained upon appeal.

The museum authorities have never permitted these

A PRIMITIVE V-WOUND COP IN THE NATIONAL MUSEUM.



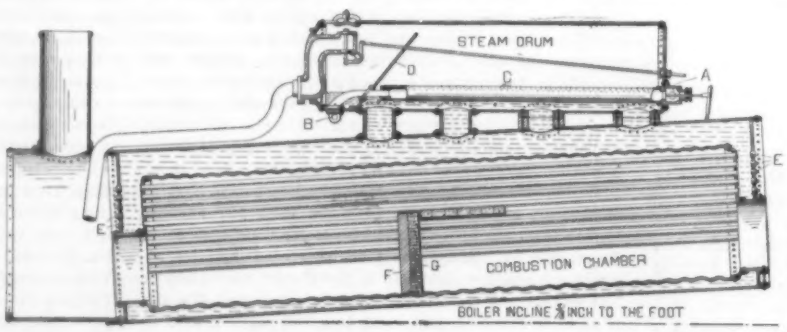
A V-WOUND COP FOR WHICH A UNITED STATES PATENT WAS ISSUED.

cops to be unwound, and it cannot be said with certainty that the inner layers, and especially the first few layers, are the same in construction as the outside one. It is possible to begin with a quite different formation and to gradually approach the Wardwell wind. The court held this to be immaterial since the outer layer might be regarded as a first layer, and a cop wound upon that.

The Patent Office has recently reissued the method patent, specifying the formation of the first layers, because of the doubt as to the internal construction of the museum cops.

AN OIL-BURNING WATER-TUBE LOCOMOTIVE BOILER.

We have received from J. B. Stetson, the President of the Northern Pacific Railroad Company, California, photographs and particulars of a very interesting locomotive which was designed by himself and W. J. Thomas, the Master Mechanic, for use on their road, which is of 3-foot gage and runs from Sausalito, San Francisco Bay, to Cazadero, 100 miles to the north. The novelty of the engine lies in the boiler, which was built on the frame of a small eight-wheel Baldwin passenger locomotive. The designers write us that the boiler was designed for the double purpose of enabling the road to burn crude California oil and of securing economies of construction and maintenance which are characteristic of the water-tube boiler. They endeavored to build a boiler that "would cost less in the first instance and, after it was built, would cost less to maintain; one that would do away with the troublesome flue-sheet with its 200 or 300 flue ends in the fire, and would also get rid of the thick seams, the rivets around the flue-sheet, to say nothing of the hundreds of stay bolts, etc."



SECTION THROUGH BOILER.

OIL-BURNING LOCOMOTIVE WITH WATER-TUBE BOILER.

The construction of the boiler is very clearly shown in the accompanying longitudinal section. It will be seen that the barrel is placed on an incline of 5/8 of an inch to the foot (this was done to secure better circulation), and that a corrugated firebox runs through the whole length of the boiler. The latter is supported at each end on a 20-inch nozzle, and about its mid-length there is a cast-iron bridge wall and flue-support, *F*, with a protection of firebrick, *G*. The oil is introduced through the nozzle at the front end of the boiler, and what is known as the sunlight type of burner is used. The oil is carried to the burner through the exhaust pipes, where it is heated to the correct temperature for atomizing. Above the boiler is a large horizontal steam dome, containing the inlet for the feed water, which enters the dome by way of the long, perforated pipe, *C*. At each end of the boiler are flue-cleaning plugs, *E*, placed directly in line with the water-tubes, by the removal of which it is an easy matter to give the tubes a thorough cleaning. The shell of the boiler is 7-16 of an inch thick. Its length, including the smokebox, is 19 feet 6 inches. The firebox is 41 inches in diameter by 16 feet in length; the shell is 3/8 of an inch in thickness; the heads, 1/2 an inch; and it contains forty-nine 3-inch tubes. It will be noticed that the cab is placed at the head of the engine, an arrangement which the designers claim gives the engineer and fireman a better lookout, especially on sharp curves, and a more perfect command of their engine. The throttle levers, valves, etc., are all placed at this end and within convenient reach.

It will be noticed that the tender is of decidedly original design, the tanks being cylindrical and placed vertically. The water tank has a capacity of 1,200 gallons, and the oil tank of 1,000 gallons. The lagging has been carried entirely over the smokebox, with the result that it is an easy matter to retain the heat; so much so, that by closing the top of the stack it has been found that steam can readily be held for as long as ten hours, and that it can then be utilized for firing up without the necessity of using any wood or coal fuel. The engine has been in use on the road for about four months, and we are informed that it is giving very satisfactory service.

Paris is the center of an international telephone wire net; its extreme ends are London, Hamburg, Berlin, and (in connection with the French-Italian line about to be opened) Turin and Milan. The Paris-Berlin line is the longest, with about 625 miles of wire. The Paris-Hamburg line is about the same. The distance from Paris to Turin, measured by an air line, is about 375 miles, and that between Paris and Milan about 470 miles. But all these lines are eclipsed in length by that between Paris and Cologne, not by the direct line, but by indirect connection, often rendered necessary by breaks in the other service. In such cases, a person in Paris desiring to speak to Cologne is connected via Berlin. This roundabout way increases the wire distance about 375 miles, making the total about 1,000 miles. The Cologne Gazette states that this does not impair the distinctness of the message, and no loss of time is noted in using this increased distance.

CAVE-IN AT THE PARK AVENUE RAPID TRANSIT TUNNEL.

When we consider the great extent of the Rapid Transit Subway, and the different varieties of rock formation which have been encountered throughout the 21 miles of excavation, it is certainly surprising that there have been so few accidents due to caving in of excavations and tunnels. As a matter of fact, there have only been three that were at all serious, one occurring in the deep tunnel that is being driven beneath Washington Heights, another at Union Square, and the latest the cave-in on Park Avenue which forms the subject of the accompanying illustrations.

It will be remembered that the Subway beneath Fourth Avenue divides into two two-track tunnels in the neighborhood of Thirty-third Street, and that these two tunnels are being driven beneath the old Park Avenue tunnel and respectively somewhat to the east and west of it, the side walls of the old tunnel being approximately over the crown of the roofs of the Rapid Transit tunnels. These latter are being driven entirely through rock, and, apparently, judging from the nature of the material encountered, the rock has been of a good, solid quality in the neighborhood of the tunnels and presumably for some distance back of them. The general dip of the strata is at an angle of 45 degrees from east to west. At about the center of the easterly tunnel, between 37th and 38th Streets, the rock is seamed with thin layers of disintegrated material which ordinarily has sufficient binding effect to keep the adjoining rock from sliding during excavation, but which, should they become saturated, as happened in the recent instance, turn to a greasy consistency, and render the rock liable to slide when the surrounding or supporting material is cut away. As a matter of fact, this is what happened a few days ago for a distance of between 30 and 40 feet, on the easterly wall of the easterly tunnel, when the rock commenced to force its way in, and had filled the tunnel for about one-third of its width before the sliding was stopped by shoring the wall heavily with timber. After the movement of the rock had been stopped, it was not anticipated by the engineers that there would be any further trouble, as there were no indications on the surface of the ground, which at this point is 60 feet above the floor of the tunnel, that the movement of the rock had extended to the surface. Between 8 and 9 o'clock on Friday morning last, however, there was a sudden subsidence immediately below the front area of one of the houses in the center of the block. The cavity was large enough to take in nearly the whole of the front steps and the heavy stone balustrade, and it extended under the front of the house, with the result that a considerable portion of the front foundation wall was carried down. At 1.30 on the same day, the front foundation wall of the adjoining houses gave way, and the whole of the steps, landings and areas, with the brownstone facing of the first story, fell into the crater, which by this time had become greatly enlarged. The building department now gave orders for all families living in the houses facing Park Avenue between 37th and 38th Streets, to vacate their homes.

It is not anticipated that the movement of the rock will extend any further, as the overlying material has probably settled down solidly against the displaced tunnel wall, which is prevented from further movement by the heavy shoring within the tunnel.

The engineers are meeting the difficulty by making an open cut above the cave-in. The shifting rock will be removed; a concrete arch turned over the tunnel; and the material filled in, restoring the normal surface of the ground. This accident should not cause any fears as to the stability of the completed tunnel, for the reason that the whole interior will be lined with a heavy wall of concrete, which will have sufficient strength in itself to resist any crushing-in effect of the kind we have just described. By the courtesy of the New York Herald we are enabled to present the three accompanying photographs, which show very clearly the extent and nature of the damage.

Front View of the Wrecked Houses.

The Measurement of Osmotic Pressure.

If a solution of ordinary salt or sugar be brought into contact with water, the salt or sugar will pass from the solution into the water until both become of the same concentration. Ordinarily this phenomenon is called diffusion. Obviously the particles of the dissolved substance are driven from their solution into the pure solvent by some force; and this force is known as osmotic pressure. Qualitatively, it is a simple matter to demonstrate the existence of osmotic pressure; but the measurement of the magnitude of this pressure is an experimental problem so difficult that few physicists have ever attempted its solution. To be sure, the well-known German botanist Pfeffer in 1877 succeeding in making some direct measurements; but the principal method which he employed never permitted him to measure pressures greater than that exerted by a sixty per cent solution of a substance, such as cane sugar. Meager as these results have been, they form the basis for the important labors of Van't Hoff. In 1887 this brilliant Dutch chemist showed that the osmotic pressure of solutions obeys the laws of gases. Ever since this generalization was reached scientists felt that the time had come to measure great osmotic pressures directly, and to ascertain the truth of Van't Hoff's law. But the many experiments made during the last decade have failed miserably. Finally Prof. Morse, of the Mechanical Department of Johns Hopkins University, devised a method which is brilliant as well as simple. For some years Prof. Morse has been engaged in important electrolytic work. It occurred to him that instead of allowing the two solutions to diffuse from the two sides of a cell into a porous wall, they might be forced in by means of the electric current. In carrying out the idea he poured a solution of potassium ferrocyanide into the cell; immersed the cell in a solution of copper sulphate; inserted an electrode into each solution; and passed a current from the outer solution through the walls of the cell into the inner solution. The positively charged copper ion moved with the electric current into the wall from the outside; the negative ion of the potassium ferrocyanide moved against the current and passed into the wall of the porcelain cup from the inside. When the two ions met they combined and formed the desired precipitate into the walls of the cup. The precipitate offered far more resistance to pressure than that deposited by the method of Pfeffer.

After long and arduous labor Prof. Morse succeeded in securing junctions in the apparatus that would withstand high pressures, and has solved other difficult problems that have arisen in the course of his work. So successful is the method devised by Prof. Morse that pressures as great as twenty-three atmospheres have been measured. Last June Van't Hoff visited Johns Hopkins University. Unhesitatingly he pronounced the work that Prof. Morse had then merely begun the most important in modern physical chemistry. Coming from one of the greatest living chemical physicists, this is high praise indeed.

Looking into the Crater from Steps of Adjoining House.

Snapshot Taken as the Front Walls Collapsed.

CAVE-IN AT THE PARK AVENUE RAPID TRANSIT TUNNEL.

Correspondence.

Heavy Rapid-Fire Guns.

To the Editor of the Scientific American:

I have read with interest a recent letter from a correspondent in your valued paper in which the batteries of our new armored and protected cruisers are contrasted unfavorably with those of similar craft in the Italian and Japanese navies. The same correspondent adds that no such criticism applies to the armament of the new battleships. So far as the number and weight of the guns is concerned this last statement is doubtless true. In this respect the ships of the "Pennsylvania" class seem rather overgunned than otherwise. A question arises, however, concerning the comparative efficiency of the eight 8-inch guns which form a part of these batteries. These are all listed officially as "breech-loading rifles." I have noticed, however, that all guns of this caliber in foreign navies are classed as "rapid-fire guns," while there are no guns of this classification in our navy above the caliber of six inches. On the other hand the Scientific American has stated that all of the guns in our new battleships are to have the improved Welin breech mechanism, which will presumably make them as efficient as any. The question that arises is this: Is the difference between the new 8-inch "breech-loading rifles" of our navy and the 8-inch "rapid-fire guns" of foreign navies merely one of nomenclature, or is it true that we are still clinging to the old slow-fire principle in guns of this caliber despite the fact that this practice has been universally abandoned in foreign countries? I request that the Scientific American furnish its readers with an answer to this question.

A. C. Reiley.

2682 Broadway, New York.

[The new 8-inch naval gun is entitled to be called a rapid-fire weapon. It embodies the rapid-fire features which are found in the European rapid-fire pieces of the largest caliber.—Ed.]

Quartz Fibers with the Elçctric Arc.

To the Editor of the Scientific American:

Quartz fibers of small and uniform diameters fit to be used for galvanometer suspension or cross hairs in telescopes or transits can be made only with the aid of heat of sufficient intensity to liquefy the quartz. The usual source of heat is the oxyhydrogen blowpipe, but it quite often happens that this apparatus, with its cumbersome gas cylinders, are not at hand when the fibers are most needed, with the result that the experimenter or observer often contents himself with a spider-web cross hair or a suspension of unspun silk, which are both unreliable and short-lived. The writer has found this quite unnecessary if an ordinary electric arc is accessible. The arc is preferably provided with a hand-feed, but the ordinary automatic feed may be so adjusted as to give a gap of about one-fourth of an inch. A crystal of transparent quartz should now be brought near to but not within the zone of incandescent gas, and held in this position till it is thoroughly heated. If heated too rapidly the crystal will chip and the fragments be thrown about with violence. After heating, the crystal may be brought in contact with the incandescent spot on the lower carbon and a piece about the size of a kernel of wheat melted off. This should be seized with a pair of forceps and drawn out to a length of about half an inch as it is removed from the carbon. Another piece of quartz similar in size is now melted on the carbon, and after it has become quite liquid the quartz already melted should be brought in contact with the bead and quickly withdrawn. If the movement is rapid and the direction of the pull is not such as to draw the thread across the column of heated gas, a very fine fiber of uniform diameter will be the result. Much depends upon the quickness with which the fiber is drawn out, and any scheme to increase this will improve the results.

If the operator stands on a well-insulated platform there need be no fear of the current.

Marinette, Wis. Clarence W. Eastman.

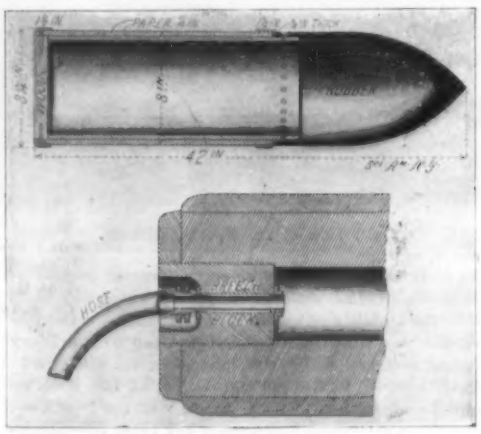
[The experimenter is warned against trying this experiment on a lamp placed on a circuit having more than 100 or 200 volts E. M. F.—Ed.]

A new extensometer has been designed by Mr. H. T. Bovey, for determining the longitudinal extension or compression of any given length of a horizontal beam loaded transversely. It was recently described in the Transactions of the Royal Society of Canada, and consists essentially of two parallel overlapping steel bars, the opposite ends of which rest by knife blades against two points on the specimen to be measured. Between the faces of the two bars is a small roller carrying a mirror. An extension or compression of the specimen causes relative motion of the bars rotating the roller through a small angle, which is readily observed by means of the mirror, the reading being effected by means of an ordinary telescope with cross hairs.

Shell Practice in City Armories.

In the large Armory of the Thirteenth Regiment, Brooklyn, there are mounted complete working models of three types of coast-defense guns, a 12-inch mortar, an 8-inch disappearing rifle, and a 4-inch rapid-fire gun, which were built especially for the Armory by the Bethlehem Steel Company at a cost of $25,000. They are perfect working models, and the dimensions, form, and functions of every part are exactly the same as in the army guns installed in coast fortifications, the only difference being that the models, which are built chiefly of wood, are very much lighter than service pieces, and, of course, cannot be fired with powder charges. But since the traversing and elevating mechanism and the mechanism of the breech of the gun are of metal and identical in design with the service gun, it follows that the gun detachments secure the full benefit of drill with the actual guns in handling these models.

It occurred to Lieutenant Kingsley L. Martin, who is one of the civil engineers in charge of the construction of the new East River Bridge, that the value of the gun drill, to say nothing of its interest, would be greatly increased if the weapons could be arranged to fire dummy shells at actual targets in the Armory. Powder was impracticable for three reasons: First, that there would be danger of cracking the thin cast-iron linings which are inserted in the dummy guns to carry the rifling; secondly, that the concussion and noise of the discharge would be undesirable and dangerous to the glass windows and lighter structures of the Armory; thirdly, that no projectile that would withstand the shock of powder discharge could be made so light as not to injure the Armory floor when it fell. Accordingly, with the sanction and encouragement of Colonel David E. Austen, commanding officer of the Regiment, Mr. Martin designed and had built the plant which forms the subject of our illustrations. Compressed air was selected as the substitute for powder most suited to the case. This was furnished by an electrically-driven, direct-connected compressor with an automatic governor. The air is stored in a series of flasks and in the large 6-inch main which runs around the building below the galleries, at a pressure of 130 pounds to the square inch. The compressor runs until the desired pressure is reached, when the governor cuts off the current. When the gun is fired the resulting drop of pressure, acting through the governor, starts the compressor and renews the supply of air.



DETAILS OF DUMMY SHELL AND COMPRESSED AIR ATTACHMENTS AT BREECH OF 8-INCH GUN.

The compressed air is led into the powder chamber through the breech-block in the manner shown in our illustration. The mushroom head and the spindle were removed from the breech-block and a 2-inch pipe threaded at its ends was introduced in place of the spindle, and an air-tight connection made by screwing up a pair of flanges tightly against the front and rear faces of the breech-block. To the outer end of this pipe a length of fire-engine hose was attached by means of a couple of clamps, the other end of the hose being connected to the compressed air main. When the order to fire the gun is given, a quick-opening gate valve admits the air instantly to the gun.

The first projectiles used were cylindrical with flat heads, but for the future, pointed heads of molded rubber, of the kind shown in our illustration, will be substituted. In the earlier projectiles, the body was made of rubber belting for the 8-inch and of leather for the 12-inch gun, the heads and bases consisting of cup leathers. The 4-inch shells were paper tubes with wooden disks at the ends and a felt rifling band. The new 8-inch shell, shown in our engraving, consists of two cylinders of paper each one-quarter of an inch in thickness, with a disk of wood at the base, and with the overlapping pointed rubber head riveted to the inner cylinder, as shown. As we have already stated, the guns are fitted with a half-inch liner, in which the rifling is cut. The rifling band in the case of the dummy shells consists of a strip of felt or leather, and it was found that this answered admirably.

In a recent trial of the guns, the gun crews were taken from the Third Battalion of the Regiment. Base lines and stations had been previously established, and the azimuth, plotting-board, and range-finder were used in getting the proper elevation, etc., just as they would be in actual service. The stations were connected by telephone and also signal flags, wielded by members of the signal detachment of the regiment, were used as a means of communication. Twenty shots were fired from the larger guns and twenty from the 4-inch rapid-fire gun, the majority of which were hits; and this in spite of the fact that the target was moved and the angles frequently changed. Encouraged by the success of the installation, Colonel Austen is endeavoring to secure an appropriation of $1,000 for a permanent equipment.

A. L. Barber's Steam Turbine Yacht.

Up to the present time, the turbine has been applied to only four vessels by European shipbuilders—first to the torpedo-boat destroyer "Turbinia," then to the destroyers "Viper" and "Cobra," belonging to the British navy, and, lastly, to the passenger steamer "King Edward," which was finished on the Clyde in July, 1901, and used as an excursion boat between Glasgow and Campbelltown during the summer. This vessel is 250 feet in length between perpendiculars, 30 feet in molded breadth, and 17 feet 9 inches in depth, molded to promenade deck. In nearly all respects she is similar to the usual modern type of river or coasting pleasure steamer, only slight changes having been introduced to suit turbine machinery, which consists of three separate turbines driving three screw shafts. The speed obtained by the "King Edward" was about 20 knots.

The first order received by any British shipbuilder for a turbine yacht has come from an American—Mr. A. L. Barber of New York. Messrs. Ramage & Ferguson of Leith are building this yacht to the design of Messrs. Cox & King, of London. She will be 252 feet 3 inches on the water line (about 300 feet over all) with 32 feet 6 inches beam and a molded depth of 21 feet.

The turbine machinery will not be materially different from that of the "King Edward," in which the high-pressure turbine is placed on the center shaft, carrying one propeller, and the two low-pressure turbines each drive one of the outer shafts, each of these shafts carrying two propellers. In the exhaust ends of each of the latter are the two astern turbines, which are in one of the low-pressure motors, and operate by reversing the direction of rotation of the low-pressure motors and outside shafts. When the vessel is going ahead, the steam from the boilers is admitted to the high-pressure turbine, and after expanding about five-fold it passes to the low-pressure turbines, is further expanded in them twenty-five fold, and then passes to the condensers, the total expansion ratio being estimated at 120-fold. It is said that at 20 knots the revolutions of the central shaft are 700 and of the outer shafts 1,000 per minute. Only the outer shafts are used when going alongside of a wharf, and the steam is admitted by suitable valves directly into the low-pressure motors or into the reversing motors on each side of the vessel.

The yacht will have an indicated horse power of 2,500. As to the speed expected to be obtained, the designers will say no more than it will not be less than 16 knots. In regard to the coal consumption of turbine engines per indicated horse power, as compared with ordinary engines, there seems to be some uncertainty. In this respect the "King Edward" on her trips last summer was fairly economical, but this test is hardly a satisfactory one in arriving at the probable coal consumption of a turbine yacht, for the "King Edward" ran continuously at high pressure from Glasgow to Campbelltown and return, whereas a yacht on a cruise will steam at varying rates of speed.

This turbine yacht will be completed in about ten months.

The Current Supplement.

The front page of the current Supplement, No. 1369, is devoted to a brief account of the Victor Hugo centenary at Paris. Chemists will find an interesting article on the stratification of hydrogen by Sir William Crookes. The new Bermuda floating dock is fully described and pictured. John Meikle discourses interestingly on "A Bit of 'Ancient' History of the Isthmian Canal Problem." Among other articles may be mentioned a description of the Prince Regent Theater at Munich; the machinery of the Wagner Siegfried performance; and the "Padlocks of Indian Chests." Prof. S. P. Langley and F. W. Very describe the cheapest form of light, which happens to be that of the insect *Pyrophorus noctilucus*.

Engineering Notes.

The semi-annual report of the London and Northwestern Railway shows a decrease of working expenses amounting to £32,809, and an increase of receipts of £39,270. According to the report, this result is to be attributed largely to the adoption of American methods of haulage and to the use of American engines. The heavier engines used resulted in a saving of 329 trains between certain points.

The report of the workings of the German canals states that there are 8,650 miles of inland waterways open to traffic. In 1900 nearly seven million tons of goods were conveyed to Berlin by the canals, and eight and a half million tons to Ruhrort. The Elbe has been made navigable for 550 miles. The canal between the Elbe and the Trave has been completed at a cost of five million dollars.

The recently organized National Bridge Company of Pennsylvania has secured a 40-acre site for its new plant at Colonia, on the Pittsburg and Lake Erie Railroad about twenty miles from Pittsburg. This plant will have a capacity of six thousand tons of structural steel per month, and after the bridge department is in working order, a steel-car plant with a capacity of twenty cars a day will be put into operation. The main building will be of steel frame construction and will be 200 feet wide by 550 long.

English and American capitalists are to build a railroad which is to run from Eureka, Humboldt County, Cal., to Weiser, Mont., to connect with the Northern Pacific. Eureka is a town of 10,000 in a county without a railroad. The proposed line will open this part of California, traverse the redwood country and the southeast corner of Oregon, cross Idaho and finally merge into the Northern Pacific. The road, it is claimed, will open a territory containing about 250,000 population at present, and capable of supporting a million, but now without proper traffic facilities.

Baron d'Estournelles de Constant of France has been on a tour of the United States with a view of securing some data about the industrial schools of this country, and to bring about better industrial relations between the people of the two countries. His government has practically decided to establish a school in this country where French youths can be sent for instruction in American methods, and this institution will be located in Philadelphia. The Baron also wants to encourage the sending of American students to the schools of his country, and he thinks the exchange of knowledge or practice thus brought about would be very beneficial to the interests of both countries.

Orders for machinery from South African mining companies have not been as plentiful since the little misunderstanding between John Bull and Oom Paul, but now there are unmistakable signs of renewed interest and activity among the operators, and the indications point to an early revival throughout that section. One of the most notable orders with Westinghouse, Church, Kerr & Co., is for two 1000-kilowatt Westinghouse-Parsons turbo-generating sets for the De Beers Consolidated Mines, Limited, for shipment to South Africa. This equipment will furnish current for a power transmission system in the De Beers mines, and it is expected that it will mark an important departure.

Mr. Ralph Noble, the electrical engineer of the Morgan-Gardner Electric Company, of Chicago, has invented a special electrical coal-cutting machine to suit the peculiar "longwall" system of mining practised in the English coal mines. The object of this particular machine is to undercut the coal. The first work of the miner is to cut under the seam so that it can be blown down. It is hard and wasteful work. As the miner must cut in some distance up the seam, a certain amount of coal is turned into slack by working upon it. The Morgan-Gardner electric machine undercuts to a depth of 6 feet a space of 4½ inches in height, and 3 feet 9 inches wide, without any waste whatever. The machine skids back automatically when it has cut its full length, and is reset for the next section in less than a minute. It cuts 242 square feet in an hour, doing the work of fifteen men. After a section is cut in this way holes are bored by electric drills and the coal blown down. Such machines can only be used when the "pillar and stall" system of mining is carried on. The new machine invented by Mr. Noble for use in England undercuts the face of the coal when the seam is sixty or seventy yards wide, after the manner of a reaping machine. It costs from $1,500 to $2,000. The machine is also used for cutting roadways, and in one of the English mines in which it has been installed, it is at present used in cutting out a band between two seams of coal, which otherwise could not be moved without great waste. The use of the machine involves a saving of from 12 cents to 36 cents per ton of coal mined, according to the thickness of the seams. It thus enables many mines with small means, which are now disused, to be worked at a profit.

Science Notes.

In County Mayo, Ireland, a wooden boat believed to be nearly 2,000 years old was recently dug up by some laborers. The boat, beautifully carved from the trunk of a tree, is of oak, 46 feet long, and in a perfect state of preservation. So hard is the wood that the hatchets of the men scarcely left an impression. Provision will be made to receive the relic in the Dublin Museum.

The Imperial Health Department of Germany, which numbers among its counselors some of the most distinguished scientists, has lately considered the possibility of exterminating rats throughout the empire. It is the object of the health department to mitigate the danger from the spread of contagious diseases. Dr. Robert Koch, the eminent bacteriologist, has been commissioned to devise a plan of getting rid of the rat pest in the east port-towns.

Dr. F. W. Hutchinson, the well-known English scientist, is at present making a series of balloon ascents from London and vicinity with a view to determine the nature of the bacilli inhabiting the upper regions of the atmosphere. The microbes are collected by means of sterilized gelatine plates, prepared from seaweed by a Japanese process, and exposed at different altitudes. So far the results have been satisfactory, and many hitherto unknown germs have been discovered.

The work of gathering specimens for the public conservatories of New York city, in Bronx Park, is proceeding at a rate that cannot but arouse satisfaction. The collections in the older houses, and a considerable number of plants grown during the year in the propagating houses on the eastern side of the Botanical Garden, will partly stock the large additional space. Nevertheless, several thousand more specimens are needed for the new houses. To obtain some of these, three expeditions have been organized. Dr. McDougal has gone to Arizona to secure cacti and succulents; Dr. Britton may go to Cuba in order to gather certain tropical species; and Mr. Nash will go to Europe in April in order to arrange for some exchanges for the Botanical Gardens.

The London Lancet is doing splendid work in its laboratory for the public health of Great Britain, and it has been considering that the postage stamp is not too unimportant for its attention. Blood-poisoning has, without a doubt, been traced to licking an infectious postage stamp as a cause, and the chances of a postage stamp becoming infectious are obviously abundant. This year it was decided to revert to red as the distinguishing color of the penny stamp. On examination it is found that one of the innocuous aniline reds was used, which is peculiarly resistant to atmospheric action or to the action of moisture. Strong acids disturb it but little. The adhesive material is dextrine or British gum in all cases.

Children of wealthy parents are to be the subjects of food experiments by scientists in a splendidly equipped home known as the Chicago Hospital School for nervous and delicate children, at 5201 Drexel Avenue, says the New York Medical Journal. Only the well-to-do can afford to send their children to the school. The home can accommodate only fifteen children, and has more applications than it can fill at the present time. An annex is to be established soon, and the effects of food on the brain and body are to be studied under the direction of Dr. John M. Dobson, when he returns to Chicago from Boston, where he is understood to be conducting further researches in the subject. All conventional ideas of a school are to be disregarded at the hospital school. There will be no desks; and nothing to suggest an institution will be allowed. The idea of working out such a problem originated with Dr. John M. Dobson, dean of Rush Medical College. The hospital school is affiliated with Rush College.

Some twenty years ago a German engineer who was surveying for a railway in Asia Minor heard that a large marble statue had come to light in what is known now as the town of Bergama. He soon became convinced that owing to the largeness of the remains it formed a part of the representation of the battle of the gods which took place on the heights of Pergamon. Further investigations proved this to be the case, and Herr Humann conducted the explorations between 1878 and 1886 upon the spot where he made his first find, the Prussian government providing the means. Much of the magnificent temple and altar which were erected on the Pergamon height between the years 197 and 159 B. C. had disappeared under the combined influences of the weather and vandals. Some larger portions and small fragments were conveyed to Berlin, and now a special museum has been opened for the reception of these magnificent specimens of Hellenic art. The building in shape and size resembles the original altar with its frieze. The gigantic figures have been set up in their former order, and every possible fragment has been utilized.

Electrical Notes.

A charter has been given to Boston capitalists to build an electric line from Toronto to Cornwall and a line from Brockville through Smith Falls to Ottawa, in all about 350 miles. The fund for this purpose will be $8,000,000, and the work will be pushed to an early completion.

In order to facilitate the handling of mill products and supplies an electric railway has been built entirely encircling the Carpenter Iron Works at Reading, Pa. The track is twenty-four inch gage and is laid to reach all the departments of the works as well as coal piles and railroad sidings. There are two electric locomotives weighing 10,000 pounds each and capable of a speed of six miles an hour with a draw pull of 1,200 pounds. The line is equipped with a variety of cars suitable for the work required.

In a recent number of the Electrical Review, Prof. Trowbridge describes some interesting experiments which he made with the electric spark in water. He states that it is possible to produce a brilliant discharge in carefully distilled water, provided a high electro-motive force is employed. He has found 500,000 volts with a large capacity suitable for the purpose of spectrum analysis. The electrodes were platinum wires inserted in long glass tubes and placed an inch apart. It was necessary to have an additional spark gap outside the liquid. Prof. Trowbridge states that the light of the spark produced under water is of brilliant whiteness, resembling that of an inclosed arc-lamp.

A scheme is being promoted for the purpose of constructing a railway upon the monorail system between Edinburgh and Glasgow. The plans have been prepared and the route mapped out, and these have as a preliminary been submitted to the Board of Trade. The distance between the two cities is 49 miles by the most direct route possible, and the distance will be covered in 29 minutes, or at a relative speed of 117 miles per hour. A service of six trains per hour both ways will be inaugurated. At present the two cities are connected by the North British and Caledonian system, and the service is about hourly each way, the fastest train covering the distance in 65 minutes. An immense traffic passes between the two cities.

An instrument for indicating and recording the approach of thunder storms is in use at St. Ignatius College, Cleveland, Ohio. The apparatus comprises a relay, a sounder, a coherer, two condensers, a choking coil, two batteries of two and four dry cells, a clock with recording cylinder, and a copper collector fixed to the tower roof. The action of the storms upon the recorder is as follows: If, at some distance from the receiving station, there is a violent discharge of electricity within a cloud, the electrical oscillations it occasions will impinge upon the collector on the roof and close the coherer circuit. The waves, however, pass the coherer without obstruction, thereby building bridges for the battery current in this circuit. The relay in the coherer circuit is energized, and closes the recorder circuit in the usual manner.

In a recent issue of the Tramway and Railway World, Mr. Magrini Effren of Turin shows how rapid and extensive has been the development of electrical traction in Italy. The first electric tramway put down in Italy dates back to 1890. The line runs from Florence to Fiesole. Genoa and Milan followed in 1893. Two years later the Eternal City itself saw the advent of the electric tramway. Turin, Naples and Leghorn and other cities are now included in the list. Water power instead of steam is used at the generating stations, in many cases. While the railways, as a rule, have adopted a conductor rail, the use of overhead wires for the tramways is quite general. The latest development is the Lecco and Sondrio Railway, about which so much was heard at the recent arbitration proceedings regarding the system of electric traction for the Metropolitan and District Railways of London.

Several severe experiments have recently been made in Christiania with a new electro-magnetic gun invented by Prof. Birkeland. The electric connection between the battery and the gun is made in less than a second by the aid of a current breaker. The feature of this weapon is that no noise accompanies its firing. In the trials the electric spark was first seen, followed by a loud report, which was caused by the impact of the projectile, a one-pound shell, on a wooden target, which was penetrated. The gun works magnetically. The shell is drawn out of the bore and not, as hitherto, impelled by gunpowder. The use of magnetism as a motive power, according to Prof. Birkeland, will enable 1,000-pound shells to be hurled much further than by the old-fashioned methods. This is by no means the first gun with which attempts have been made to fire shells by magnetic means, but no electro-magnetic gun has yet succeeded in fulfilling the requirements which were claimed for it, so that Prof. Birkeland's further experiments will be followed with great interest.

THE SEVERO AIRSHIP.

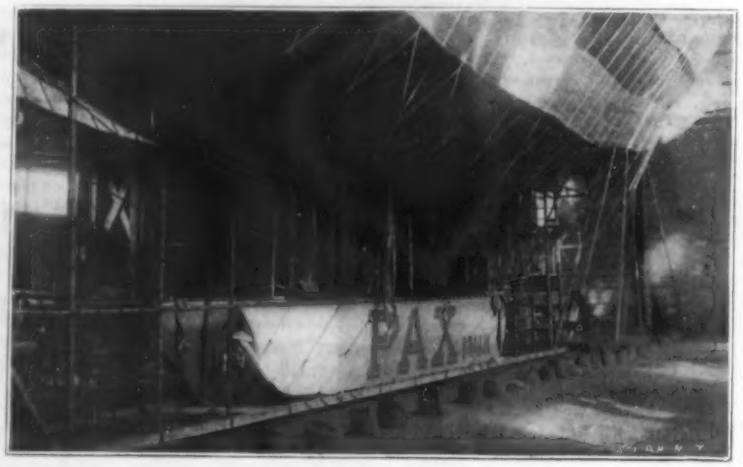
BY OUR PARIS CORRESPONDENT.

One of the most remarkable and seemingly the most practical of the different airships which are now being constructed in Paris is that of M. Severo, a Brazilian aeronaut. In the ordinary type of airship where the car is suspended from the balloon by wires, the screw, fixed at one end of the car, propels the latter and the balloon is dragged after it against the resistance of the air. M. Severo proposes to overcome the objections arising from this construction by arranging the car so that the screws will drive the balloon directly in its axis and make the balloon, so to speak, self-propelling. He carries this out by adopting the form shown in the diagram in elevation and section; the framework has the form of a trapezoid with its long side uppermost, and the latter lies in the axis of the balloon which partly envelops the frame. This framework is supported from the balloon by wires which are attached to its lower part.

The details of M. Severo's airship present many points of interest. The balloon proper measures 93 feet long and 38 feet at the greatest diameter; it is not, however, symmetrical in form, but has a considerably larger diameter toward the front than in the middle. It has a capacity of about 2,600 cubic yards and can carry a net load of 3,500 pounds. In the middle it has a large slot-like space in which is lodged the upper part of the car.

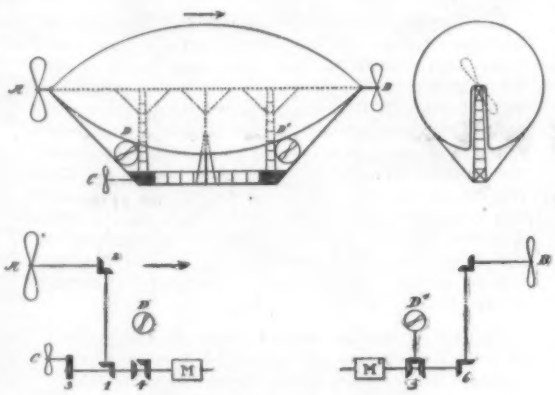
A view of this framework before mounting and another showing it joined to the balloon are presented in the engravings. The lower part, which forms the platform of the car and contains the apparatus, is 46 feet long. At each end is a gasoline motor with its appliances. The framework is relatively narrow, and measures but 3 feet at the base and 2 feet at the top. Most of it is constructed of bamboo poles of various diameters, while the flooring is of light wood. Aluminium has been used in a few cases, and the frame is well braced with steel wires. The whole has the appearance of extreme lightness, in spite of its size, combined with rigidity, and the construction has been well carried out. The car is suspended by an auxiliary covering which surrounds the balloon, composed of strips of canvas joined together by cords. This arrangement will be noticed in one of the engravings. From the lower part of the envelope is suspended the frame by a series of wires.

The system of screws and the steering device are also of a novel character. The position of the screws will be best solved in the diagram, where *A* is the main propelling screw placed in the rear and is the largest of all. It has two branches and measures 20 feet across; it is built of a steel framework and wood blades covered with cotton. The second screw, *B*, is placed in front, also in the axis of the balloon, and measures 13 feet across. It has the same general form as the front helice, but has a different pitch. Its object is to diminish the resistance of the air in front of the balloon and combat the wind, which may be opposed to the forward movement. A third and smaller screw is shown at *C*; it is placed below at the end of the platform. The object of this screw is to overcome the resistance offered by the lower part of the framework, which projects out of the balloon by 6 feet or more. As the platform contains the motors with their gasoline and water reservoirs, the mechanism and the aeronaut, and as this part is out of direct line with the propelling screw, it might offer a considerable resistance which would hinder the movement of the airship. To counterbalance the air-resistance offered by this portion of the car the small screw is provided, which measures 10 feet across. The steering apparatus is another novel feature. M. Severo considers that the different



THE SEVERO AIRSHIP.

types of rudder which have been used heretofore present many objections and he has decided to suppress them altogether and use instead a pair of small screws at each end of the car. These are shown at *D* and *D'* in the diagram, and are placed crosswise of the balloon, mounted in a light framework. To turn the balloon to one side the front pair of screws are turned in one direction and the rear pair in the other, and when the angle is sufficient these screws are stopped and the balloon continues in a straight line. The screws have another advantage in overcoming to some extent the



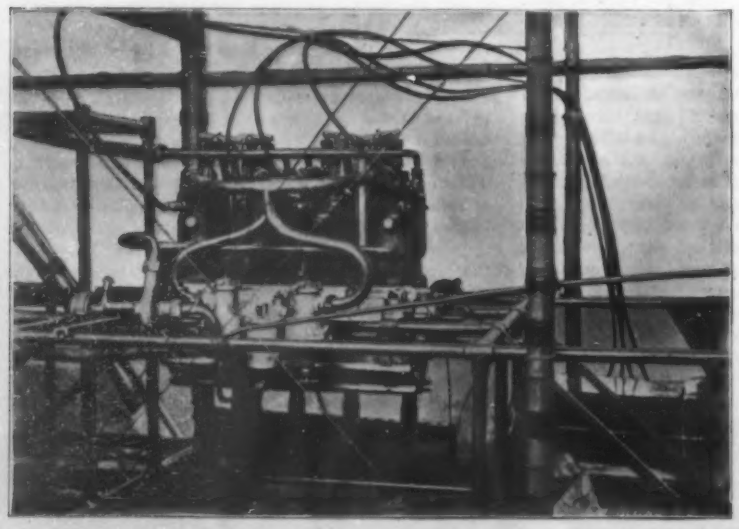
DETAILS OF AIRSHIP SCREWS.

force of the wind when it comes at right angles to the balloon. By working all four screws in a direction contrary to the wind its effect is more or less counterbalanced. It is also expected that the balloon may be made to turn about its vertical axis while in one spot by means of these screws.

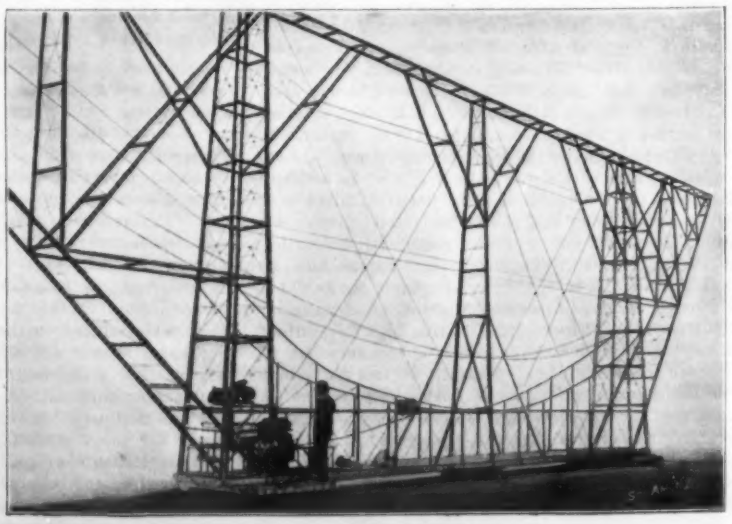
To operate all the different screws requires a number of mechanical transmitting devices, but the aeronaut has succeeded in reducing these to the simplest form. The main features of the mechanism will be seen in the second diagram, where *M* is the rear motor with its main shaft. The shaft carries a pair of friction cones, *1*, which transmit the movement to a vertical shaft carrying a pair of bevel gears, *2*, and these drive the horizontal shaft of the rear screw, *A*. The compensating screw, *C*, is driven by a pair of gear-wheels, 3, while the steering screws, *D*, are operated by a conical friction-clutch, *4*. By shifting the upper cone-wheel to one side or the other by means of a lever, the direction of its shaft is reversed and in consequence the steering screws turn in one or the other direction. In the forward part of the car is a somewhat similar arrangement. The motor, *M'*, operates the steering screw, *D'*, as above, and at the end is the transmission for the front screw. The framework, where it enters the body of the balloon, has a protecting covering of cotton cloth to prevent it from rubbing against the silk of the balloon and thus injuring it. The balloon will be provided with air-bags for keeping it filled out as the hydrogen escapes. The whole airship will weigh, when completed, about 4,850 pounds. The water and gasoline of the motor will serve as ballast and will be consumed instead of being thrown overboard, thus giving an economy to the weight. The airship has been built in the establishment of H. Lachambre, one of the principal balloon constructors of Paris. One of the views shows the balloon while filled out with illuminating gas in order to give it a preliminary test as to capacity and tightness. When finished it will be filled with hydrogen from a generator which has been installed on the premises, and M. Severo expects to try it first on the ground surrounding the balloon-shed, and then if successful to make a tour in the neighborhood of Paris.

The Jardin des Plantes, of Paris, has lately been presented with a specimen of the hyena-dog or *Lycaon Pictus* by M. L. du Mazel, a government official at Senegal. This is the first specimen of the animal which has been obtained in France. M. Oustelet, of the Zoological Gardens, has given some information pertaining to this animal. It inhabits especially the region south of the Sahara and is found in south and east Africa, at the Cape, at Kordofan, in the Somali country and Soudan, but seems to be wanting in the Congo region. It lives in holes, at least for a part of the time, and preys upon the antelope especially, which it attacks with ferocity. These burrows are, however, only a temporary shelter. The female retires to them to give birth to her young, but when these have been sufficiently reared, the burrow is abandoned. The lycaon has a greater resemblance to the dog than to the hyena but its coat is somewhat the same color as the latter, being irregularly mottled with black and white upon a yellowish ground. The hind legs and rear of the body are not of diminished size as in the hyena, nor is the dentition the same. In these respects it more closely resembles the dog. On the other hand, the paws have but four toes. The lycaon seems to have been known in ancient Egypt, and it could have been brought there from the Kordofan region. At least that is the opinion of M. Francois Lenormand, who thinks he is able to recognize it in a certain animal found in one of the Egyptian tomb-paintings.

Britain makes $20,000,000 a year profit out of its postoffices.



BUCKET MOTOR OF THE SEVERO AIRSHIP.



FRAMEWORK OF THE SEVERO AIRSHIP.

Automobile Department

NOVEL ELECTRIC VEHICLES.

THE COLUMBIA ELECTRIC TONNEAU.

The electric tonneau here illustrated is one of the Electric Vehicle Company's latest machines. Its four wheels are all of the same size. The body of the vehicle is hung low, making it more accessible to the passengers. At the same time the center of gravity is thus brought nearer to the ground, with the result of increased safety in rapid travel, especially when rounding curves. The operator's seat is broad enough to accommodate two persons. The standard machine is provided with a tonneau body. This is detachable, and in its place may be substituted either a broad surrey seat holding two passengers, a rumble seat for an attendant, or a hamper for luggage. The vehicle is driven by a double motor yielding 3½ horse power. The controller gives three speeds ahead and two backward. In order to give a clear space in front of the operator's seat the steering rod and controller handle are placed on the left-hand side of the machine. The battery is divided into two equal parts, one of which is situated over the front axle and the other over the rear axle. The weight is thus equalized and the hill-climbing capacity of the vehicle increased. The weight of the machine is 2,490 pounds. It has a radius of 40 miles per charge, and develops a maximum speed of 14 miles per hour.

THE COLUMBIA ELECTRIC TONNEAU.

THE ELECTRIC VEHICLE EQUIPMENT COMPANY'S AMBULANCE.

The above named company's specialty is the building of electric vehicles for particular purposes. The Hall Safe Company's truck, which is seen frequently on New York streets, rapidly hoisting safes to any story of a building desired by means of a special electric motor, is one of the products of this company. The company also built the ambulance herewith illustrated especially for the new Lying-in Hospital of the City of New York, according to specifications furnished it by the hospital authorities.

As will be seen from the illustration, the distinctive feature of the ambulance is the method of opening it for placing the patient within. This is done by letting down and raising one each of the two side panels, when the patient, who is placed on a stretcher, can easily be slid in. This novel and convenient arrangement was devised by Dr. James W. Markoe, surgeon in chief of the hospital. The body of the ambulance is sufficiently wide to allow a passage-way beside the patient for the physician, who enters through a narrow door at the front. The ambulance is lighted by small windows in the top in the daytime, and by a cluster of electric lights at night. It is propelled by the usual 40-cell storage battery, and is kept in a small room specially designed for the purpose and equipped with a suitable charging board. During the three months it has been in service it has given excellent satisfaction.

David Wolfe Bishop, one of the most prominent members of the Automobile Club of America, will enter the Paris-Vienna automobile race. Besides Mr. Bishop, America will send to the Paris-Vienna race William K. Vanderbilt, Jr., Foxhall P. Keene and A. C. Bostwick. Fournier has entered for both the Paris-Bordeaux and the Paris-Vienna races.

An electric automobile mail delivery was recently inaugurated in Minneapolis, and is said to have proven itself in every way efficient.

FLEXIBILITY OF THE FRAME.

For the purpose of skimming along over the asphalted streets of a large city, the ordinary type of frame answers all ordinary purposes, but when it comes to demanding service over the uncertain roads of the country it is a different proposition. Automobile frames for light vehicles as at present constructed are not always designed for the severe requirements of some of our rough country roads. The task of pulling in and out of deep ruts requires exacting conditions.

The Dayton running gear, which is shown in the accompanying cuts, has the faculty of suiting itself to all the inequalities of an uneven road. Our illustration shows the frame passing over a 21-inch obstruction without any serious difficulty.

The differential gear and double-acting band-brake are inclosed in a dustproof case at the center of the rear axle. Sockets at each side of the gear case contain ball-bearings, each consisting of 11 ⅝ inch steel balls and hardened, ground bearings adjustable to wear. The tubes entering these sockets are two inches in diameter and cover the rear axle. All the hubs contain roller bearings of approved construction, but these may be substituted by American roller bearings. The tubes at the front of the frame terminate in lugs in which L-shaped pivot-axles find bearing. These axles are connected by cranks to the steering rod which can be operated either from the center or the side of the machine.

The front and rear parts are connected by reaches terminating in standards between the tubes. The reaches are fastened to the standards by ball and socket joints, and pass through sleeves in supporting braces which also have ball and socket connections with the frame. Clips are provided at the rear and on the front of the frames on which flat springs of the usual size may be supported.

Besides the strength and flexibility noted above, adapting this frame for hard every-day use on rough roads, this frame is said to be adaptable to the needs of the automobile trade in the following respects: The gear case can either be placed in the center, as shown in the cut, or to either side desired. The reaches being separate and independent of the frame tubing can be placed near together or far apart to suit the requirements of the case, and can be made of any required length. The spring clips can be placed any distance apart, permitting the use of two springs front and rear, or lugs can be made projecting upward from the end of the tube frames, to which C-springs can be attached. All of these changes can be made without changing the frame in the least.

The cable street railways of Edinburgh, Scotland, are said to be a financial failure. The cable roads were opened in 1897, or at a time when it was well known that this system was obsolete. The original estimate was $3,893,200; the cost, $5,839,000; and work is not yet complete. The work is faulty and has already caused considerable changes.

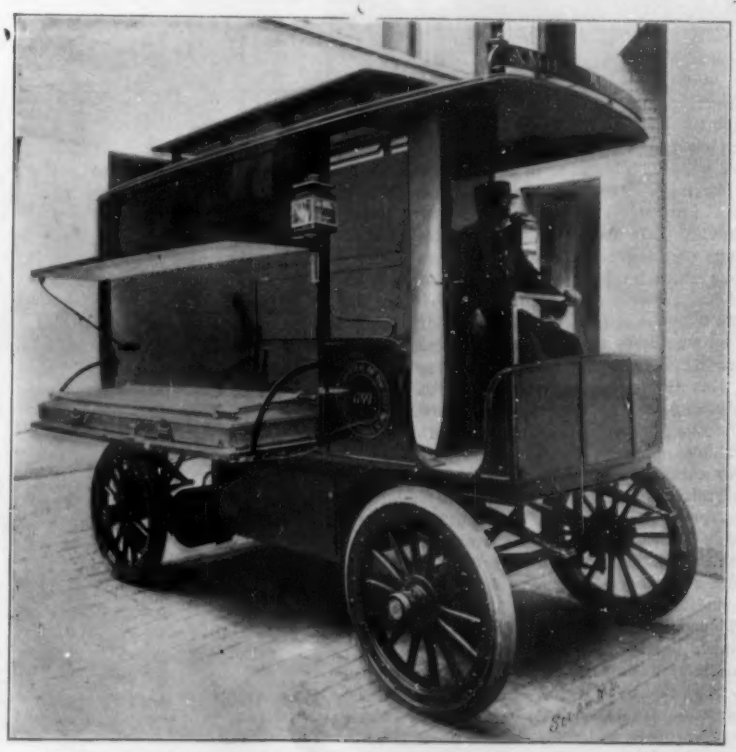
A NOVEL TYPE OF RUNNING GEAR WITH MAXIMUM OF FLEXIBILITY.

The Automobile Savings Bank.

American bankers learned a long time ago that savings deposits were to be had for the seeking, and several methods of seeking them, particularly by distributing small boxes which can only be opened at the banking office, have been used successfully. French bankers have just taken several strides in advance by introducing the automobile savings bank, which tours the country districts at stated intervals and gathers in the savings of the thrifty peasants.

An electric motor car has been built for the purpose. It provides seats for a cashier and two clerks, arranged about a revolving table. There are shelves on the walls for the bank books, and a strong box is built into the body of the car. The officials are from the Mezieres treasury administration, and the cashier has power to receive deposits of any amount. As there is no desire on the part of the authorities to facilitate the withdrawal of funds, the peasant is forced to come to the central bank when he needs money. The automobile bank began its rounds some weeks ago and has met with a most favorable reception.

Under date Feb. 26, 1902, the State Department has received from the French embassy, Washington, notice of an international competition of motors and apparatus using alcohol for generating motive power, light and heat, to be held in Paris in May, 1902. This competition will include practical tests, after which medals and objects of art will be awarded, and it will be followed by a public exposition from May 24 to June 1, 1902. The competition includes: (1) Automobile boats. (2) Lighting and heating apparatus. (3) Stationary and portable motors and motor groups. Requests of exhibitors not taking part in the competition will be received until April 15, 1902. The exhibit will include, besides motors and apparatus using alcohol, apparatus producing industrial alcohol, receptacles for storing and transporting this product, apparatus worked by exposed motors, and compounds of alcohol. Sites for exhibition are free.



THE ELECTRIC AMBULANCE OF THE LYING-IN HOSPITAL.

AUTOMOBILE COUPÉ BUILT FOR THE SULTAN OF MOROCCO.

Our illustration shows a coupé which has been built for the Sultan of Morocco by the Georges Richard Company. It is finished in green, with gold tracery. In front is the refrigerator, and in the rear the place for the footman. The interior is luxuriously fitted with silk linings and curtains, a double seat for the conductor and passenger, with the steering and controlling levers. Like the Georges Richard vehicles which have been lately described, it is on the gasoline system, and the motor, placed in front, drives the differential of the rear wheels by a belt transmission.

AUTOMOBILE BUILT FOR THE SULTAN OF MOROCCO.

A NOVEL THREE-WHEEL AUTOMOBILE.

Although the four-wheel automobile represents the type found to be in most general use, there is no doubt about the motor-bicycle and the three-wheel automobile having many friends and advocates. The admirers of the three-wheel machine claim for this type of vehicle comparative lightness and, consequently, greater traveling radius for the same amount of fuel, compactness, ease of steering, ability to turn in a circle of surprisingly small diameter, and last, but not least, a considerable reduction in the cost of this class of vehicle. As opposed to this class of vehicle there are some who prefer the four-wheel type, owing to the greater stability of this form of machine. A Philadelphia advocate of the three-wheel design, Mr. George T. Turner, is the designer of the three-wheel vehicle shown in the accompanying engravings. The vehicle is certainly very compact, as it can be stowed away in a space 7½ by 3½ feet, and it is said to be an efficient machine.

An evidence of the practicability of the Turner runabout is given in the fact that the original vehicle, constructed four years ago, is still in daily use on the streets of the Quaker City. Weighing but 400 pounds, it is yet so constructed as to safely carry two passengers over ordinary American roads with entire safety, its low running gear (but 20 inches from the ground) obviating the necessity of equipping the vehicle with a step. It has a speed range of from five to twenty miles an hour, while its tanks, with five gallons storage capacity, have proven sufficient for the round trip from Philadelphia to Atlantic City (about 120 miles) in the actual running time of but a trifle over six hours. This amount of fuel costs but fifty cents, and two passengers occupied the vehicle during the trip.

The starting, stopping and braking are all done with the one lever (with an additional foot brake). Mr. Turner is now engaged in perfecting a device by which the engine may be started from the seat.

REAR VIEW, SHOWING MOTOR OF THE TURNER THREE-WHEELER.

THE TURNER GASOLINE THREE-WHEELER.

Automobile Storage and Repair Facilities.

The proper storing of automobiles, with all that this implies in the way of taking constant and intelligent care of the machine, and the establishment of efficient repair shops, still remain in a very unsatisfactory condition, despite some commendable enterprise in certain quarters. The manufacturers of motor vehicles are well aware that a great many people are deterred from buying machines because of the lack of repair shops able to do good, responsible work. Chauffeurs of extended experience are constantly complaining of the varying grade of the liquid fuel which they pick up along their touring routes, and those who depend on electricity argue that they are constantly at odds to obtain a uniformly satisfactory charging of the batteries. Such complaints are usually well justified. Instead of dissolving their usefulness in "experience" meetings and festive entertainments, the automobile clubs might to advantage take hold of these problems with a view of alleviating the most apparent troubles of the touring chauffeur who is in search of uniform quality and excellence in liquid fuel and charging voltage.

But there is another side to the matter, affecting what will undoubtedly prove to be the most essential and useful class of motor vehicles, namely, the heavy truck, the delivery carriage, and the general utility wagon, in relation to a system of storage stations comprising city and urban limits. Department stores and similar large establishments, which are gradually displacing horse-drawn teams by horseless equipment, are already spending too much for maintaining the machines and keeping them in repair. We are slowly but surely approaching the time when centrally located storage stations will be necessary to the further economic spread of horseless traction, at least in cities. Such stations should also be able to furnish well-qualified drivers and chauffeurs to operate delivery wagons at a stated weekly or daily rate, and to take contracts for supplying efficient chauffeurs for such concerns as are constantly employing horseless traction and transportation, not only in the city, but in the suburbs and surrounding country where automobile stage lines operate. It should be possible for an individual as well as a representative of a commercial house to walk into such a storage station and immediately get a figure on the cost of operating motor vehicles, according to capacity, per day and per week. The price should include the driver's salary, the recharging of the batteries if the vehicle is an electric, or the supply of liquid fuel and lubricants if it is a hydrocarbon or steam vehicle, in order to enable the inquirer, if he is a merchant, to know precisely what the cost of each delivery would amount to. All the merchant has to do is to specify the hours of work and time schedule to be followed by the driver, and at so much per week the storage station agrees to keep the vehicle in running order, making trips with the regularity of clockwork. By this arrangement the merchant is relieved of much special superintendence, which really does not belong to his business and which he is not qualified to do properly through any of his departments. A fixed price for the vehicle and so much to make it do its limit of work and usefulness—these are the only two items which would concern the city merchant. Besides, there are any number of concerns which do not care to invest money in purchasing vehicles, but have enough expressage on their hands to warrant the hiring of one or more motor vehicles, when this can be done conveniently and economically. Only in exceptional cases does the driver of a business motor vehicle know how to properly attend to and clean it after the day's work is done. He is in a hurry to get home, and regards the cleaning of the machine as an extra job imposed upon him for the reason that there is no one else to do it. Consequently the vehicle is not taken good care of, the machine parts wear out comparatively quickly, and continued negligence may prevent the smooth working of the machinery, necessitating frequent stoppage and summons for repairs.

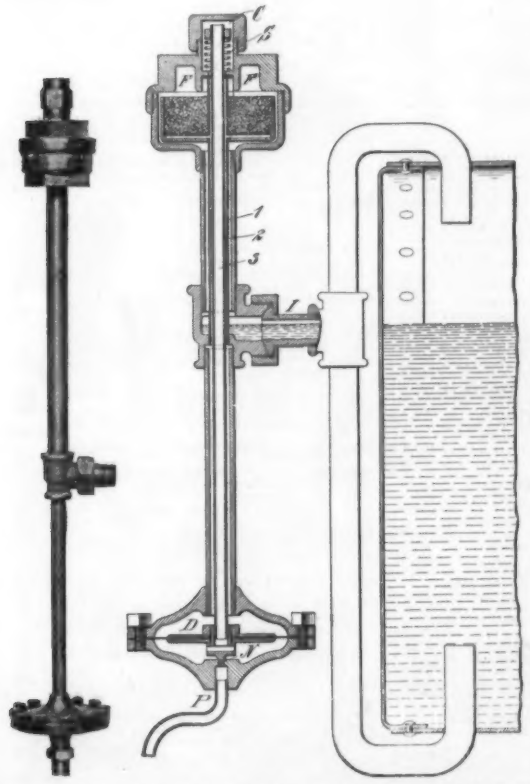
A well-appointed storage station should be able to do the work of cleaning and adjusting motor vehicles by contract for less than half the cost of the repairs, delays and loss by friction of neglected vehicles; for the cost of looking after several machines is but a little more than that for tending a single machine. In all the large cities there are at the present time dozens of expensive and well-built business vehicles which are being slowly wrecked by the ignorance and negligence of the drivers intrusted with them; and it is not at all unlikely that some of the firms, discouraged by the cost of repairs and the unsatisfactory running of the machines, may ultimately go back to the horse-drawn outfit, unless a system of storage stations comes to the rescue. At present nearly all the automobile stores are located on thoroughfares convenient to fashionable patronage; very few of them are close to the city's business heart. There are in the United States several manufacturers making a specialty of business vehicles, and these might with profit locate salesrooms, with ample storage facilities, in the business center of some of our big cities. The storage idea worked out intelligently would not only insure a large number of sales not otherwise obtainable, but would keep the seller in constant touch with the buyer—a condition both are sure to welcome. After all, the revolutionizing influence of the automobile will be felt, not through the pleasure machine, but through the manifold appliances of motor vehicles to business needs. When we are getting our fires extinguished by auto engines, our goods delivered by auto express wagons, our streets swept by auto street sweepers, our household furniture and heavy freight moved by auto trucks and vans, not to mention suburban transportation by auto stage coach, then, and first then, will the influence of the horseless vehicle assert itself in a way calculated to extract our appreciation. When we go outside city limits the conditions are simply desperate. The bicycle repair shop, the blacksmith's shop, and the general mechanic's shop are the only places of refuge, and none of them offer adequate assistance in case of accident. They merely are the local mechanical centers, which the wrecked automobilist goes through, not without a lurking suspicion that he will have to do most of the repairing himself or take a botched job. There is only one way out of this dilemma. If the automobile clubs of the United States, instead of being managed as at present purely for pleasure purposes, would amalgamate into a single compact body able to make its voice heard in legislative quarters, it should not be so very difficult to organize repair facilities all over the country by some such measure as that of the League of American Wheelmen. L. A. W. repair shops did much good in stimulating the zeal of mechanics in practical cycle repair work. The cycle repairer is closer to auto repairs that either the blacksmith or the general mechanic. It might be well worth a trial to use the L. A. W. repair men as a basis, and educate those of them who care to acquire a certificate signed by the united automobile clubs licensing them to do work as qualified automobile engineers. The essential technical instruction could very well be done

satisfactorily by mail by way of a clearly written, illustrated pamphlet—adopting the method of teaching in vogue with the correspondence schools—and the practical knowledge of how to do automobile repairs properly could soon be gained by intelligent application. But until some such method is brought to bear on the available and favorable elements in present conditions our automobile repair and storage facilities will continue to remain the weak spot in the industry.

A MOTOR SLED.

There is no reason why an enthusiastic cycler should not enjoy his favorite pastime in the winter as well as in summer. Our illustration shows a motor-bicycle which has been converted into a motor-sled by simply substituting a pair of runners for the front wheel. Mr. I. H. Whipple, the designer and owner of this peculiar vehicle, delights to race his machine against the fast horses on Chicago's speedway, which he can easily outdistance. The machine is a converted Mitchell motor-bicycle driven by a 2 horse power motor and said to develop a maximum speed of thirty-five miles an hour. As a motor-sled, however, the inventor claims a speed of forty miles an hour. By having two parallel runners in front an upright position is assured to the machine and the steering of the machine easily controlled. The runners are attached to a cross-bar secured to the front forks, and are adapted to be removed in summer time. The cross-bar, however, may be retained and serve as an axle on which a pair of wheels may be mounted, thus converting the machine into a tricycle. An additional seat may be added at the front of the machine if desired, the motor having ample power to propel the additional weight.

A MOTOR SLED.



THE CURTIS WATER-LEVEL REGULATOR—GENERAL VIEW AND CROSS SECTION.

A NEW WATER-LEVEL REGULATOR FOR STEAM BOILERS.

The accompanying illustrations give a general view and cross section of a very simple automatic apparatus for regulating the water level in a steam boiler. The device has just been patented by Mr. Nelson Curtis, of Boston, Mass., who invented it for use on automobiles, although it is readily applicable to any steam boiler.

This regulator is constructed to operate by the well-known principle in hydrostatics that a column of liquid of a given height, however small in diameter, will counterbalance or lift a great weight, provided it acts against a sufficient area at its base.

An inspection of the diagram will show the reader that the upper half of the vertical stem, above the connection with the boiler, consists of three tubes numbered 1, 2 and 3 from the outside, inward. The second of these tubes terminates below in the upper part of the diaphragm chamber, *D*, while the third one passes through the flexible phosphor bronze diaphragm and ends in the lower half of said chamber. Attached to the diaphragm on its under side is a needle valve, *N*, which is opened or closed by the fluctuations of the former. This valve, upon opening, admits boiling water and steam, through the pipe, *P*, to the supply pipe of the pump, thus checking the suction of the latter and making it non-operative; or the water and steam liberated through valve, *N*, since it has the boiler pressure behind it, may be made to operate a by-pass valve, thus checking the feed-water from entering the boiler.

When the boiler is filled with water the first time, and steam is raised, the pressure forces water up through the outer tube, *I*, the water level, of course, being then above inlet pipe, *J*, into filter chamber, *F*. It is then forced through the filter and enters tube 2 through small holes in the wall of the latter, connecting it with the narrow chamber below the filter. This water descends through tube 2, filling it, and the chamber, *D*, above the diaphragm. The weight of this column of water on the diaphragm (4 pounds) causes it to close the needle valve, *N*, which has been held open by spring, *S*, on top of tube 3.

As soon as tube 2 has filled, water is forced up into chamber, *C*, and begins to fill tube 3. The cap on top of chamber is unscrewed a little the first time apparatus is filled, in order to keep the air in tube 3 from becoming trapped at *C* when the water enters the tube.

The water thus forced into tube 3 fills the chamber below the diaphragm and, as it rises in 3, tends to counterbalance the water in tube 2. When it reaches about the middle point of 3 it has balanced half of the water column in 2, and the spring then has sufficient stiffness to lift the valve against the weight (2 pounds) of the upper half column in 2. As the steam pressure acts on both sides of the diaphragm it balances itself and can be neglected.

As soon as the valve opens the boiling water has access to the feed pump, and the latter ceases to work.

When the level in the boiler falls below the top of horizontal pipe, *I*, steam blows through into tube 3 and tends to drive out the water in it through the open needle valve. As soon as the level in 3 is in this manner lowered some six inches the weight of the water column in 2 becomes too great for the spring, *C*, to withstand, and the valve, *N*, is closed till the water level in the boiler rises above the entrance to pipe, *I*, when the same operation is repeated.

The regulator, as at present constructed, is from 15 to 24 inches in height over all, and when this height can be obtained below the water line of the boiler, pipe 1 is not needed.

It can be readily seen that the stopping and starting of the feed pump is thus dependent upon a variation of level in the boiler of about ¼ inch, or just enough difference to cover and uncover the mouth of pipe, *I*. As the apparatus has no moving parts except the needle valve, and as this is protected by a filter, it cannot ordinarily get out of order, but is continuously automatic in its action. The inventor informs us it has been in successful use for some time and has given entire satisfaction.

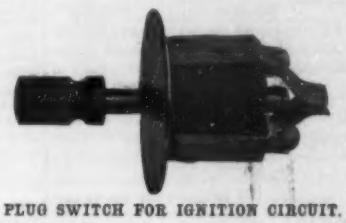
The Chicago Automobile Show seems to be doing what such an exhibition should do. The Jefferys have received seventeen orders since the Show began; the makers of the Elmore carriage have received fifty orders. Many of the manufacturers have not exhibited simply because they cannot take orders. The Show was certainly a great success. There were many buyers, and hundreds of agents who were willing to give orders and to pay cash for automobiles if they could but get the agency.

AUTOMOBILE NOVELTIES.

THE ELDREDGE VOLTMETER AND BATTERY SWITCH.—These are shown in the annexed illustrations and they will be found very useful by almost all automobilists. The voltmeter, besides being conveniently constructed in the shape and size of a watch, is an accurate instrument, and can be used in testing both primary and storage batteries.

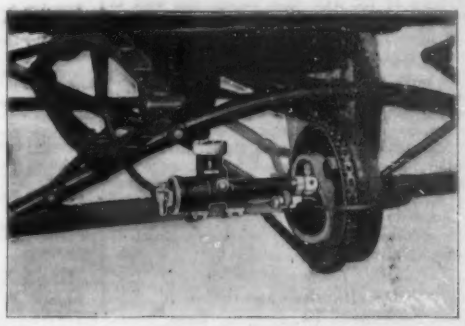
BATTERY-TESTING VOLTMETER.

The plug switch is intended for gasoline vehicles, where it is inserted in the ignition circuit. The two wires of the circuit are fastened to binding screws on the two flanges at the back, and the pin makes a connection between the two when it is pressed all the way in. When partially withdrawn, as shown in the cut, the pin is held in place by a concealed spring. The pin can be entirely withdrawn and placed by the operator in his pocket, when he leaves the vehicle, thus preventing it from being tampered with during his absence.



PLUG SWITCH FOR IGNITION CIRCUIT.

THE REASON AUTOMATIC AIR PUMP.—This is a slow running pump intended to be attached to the back axle of a steam carriage for the purpose of always keeping up the pressure in the air tank. It is entirely automatic and can be set to start and stop at any desired pressure from 5 to 80 pounds. It can also be connected so as to be started and stopped from the seat when the operator so desires. The pump is driven by a cam attached to the side of the differential gear, as shown in the illustration.



THE REASON AUTOMATIC AIR PUMP FOR STEAM CARRIAGES.

In a recent lecture in Glasgow, J. D. Dunlop had something to say of the part taken by Americans in developing the automobile. "Strange to say," Mr. Dunlop remarked, "the Americans, who are such a go-ahead people, made little headway in the manufacture of petrol cars. They have, I think, been too original, and left the beaten track too far. They devoted a great deal of time and energy to the development of the electric car, which has not proved a commercial success; it is admitted, however, that they brought the steam car to a high degree of perfection. They have now returned to the beaten track, and are making considerable progress with the more commercial petrol car."

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

TELEPHONE - RECEIVER SUPPORT. — GEORGE M. BEEBOWER, New York, N. Y. The support is so arranged as to permit the user to place his ear against the receiver and hold his head in any convenient position, or move it in any direction within reasonable limits, while the receiver is kept constantly against his ear, thus leaving both hands free to take notes or handle memoranda.

Engineering Improvements.

SPEED REGULATOR FOR EXPLOSIVE ENGINE.—O. C. WOVRINS, Dayton, Ohio. The explosive mixture and the exhaust are accurately controlled by a single rotary valve, and the latter is automatically controlled by the governor to insure a uniform speed of the engine. The valve is mounted on a shaft which is connected by a clutch to a second shaft geared to make one revolution for every two of the driving shaft. The governor is so arranged as to disengage the clutch when the engine runs too fast.

PUMPING-ENGINE. — J. J. DELANEY, Shamokin, Pa. The invention provides a simple and efficient steam pumping-engine which has but few wearing parts and is capable of high piston speed without lost motion. The steam is admitted to the cylinder to cushion the piston at the end of its stroke and to reduce jars. As the piston reciprocates, a roller mounted on the crosshead alternately engages arms which are adjustably connected with a rocker to throw the latter first one way and then the other. The rocker gives an intermittent reciprocating motion to the valve-rod which may be varied according to the speed of the pump. The valve-rod passes through a check-cylinder so arranged as to permit a rapid initial motion of the rod and the slide valve connected therewith, insuring the quick closing of the steam inlet port, and then a subsequent slower motion, allowing time for expansion.

Hardware.

DOOR-LATCH-OPERATING DEVICE.—T. G. LESLIE, East Melbourne, Victoria, Australia. An annulus is fastened to each side of the door, and screwed on to the lock spindle are the knobs bearing respectively against the annuli. Pins project from each annulus and fit loosely in slots in the knobs to limit their turning movement.

MANICURE-KNIFE.—W. S. REED, Smyrna, Del. The implement is designed for use in cutting, trimming, filing, scraping, cleaning and otherwise caring for the nails of the fingers and toes. The handle is provided at one end with a knife blade and a file blade. The latter is provided at its outer extremity with a nail-cleaner, a nail-scraper, and a portion which is formed as a lifter for lifting up and pressing back the flesh and skin at the root of the nail. The handle is constructed at its upper end to support a rotary cutter for trimming the nails.

CURTAIN-POLE RING.—A. HOTHAN, Brooklyn, N. Y. The invention relates to curtain-pole rings having rollers travelling on the pole. Each projecting end of the roller axle is bent in a U-shape, and they enter respectively the openings on each side of the roller recess. Notches in the axle ends engage the wall of the ring to prevent the roller from dropping out when removed from the curtain-pole.

VALVE.—N. OBOLENSKÜ, Hermitage, N. Y. The invention relates to check-valves and aims to give convenient access to the working parts at any time, and to allow quick replacement of worn-out parts with new ones. On one side of the valve body is formed an extension, containing a cage consisting of bars, to each end of which valve-seats are secured. The cage is therefore reversible. Midway between the valve-seats a stop is arranged for limiting the opening movement of the valve, which is preferably in the shape of a ball.

Miscellaneous Inventions.

GUN BARREL.—W. F. COLE, Waco, Texas. It is well known to expert gunners that the higher the force of the charge, and the greater the pitch of the rifling, the more liable is the projectile, especially in small firearms, to ride or cross the riding, so that no rotation is imparted to it. On the other hand, if the pitch of the rifling is reduced, the rapidity of rotation is lessened, and the trajectory impaired. This invention, which applies to small firearms, has a bore which is smooth throughout. The bore is cylindrical at the breech and throat, but is elliptical and uniformly twisted in the remaining portion, thus giving a rotary motion to the projectile.

TAG-FASTENER.—S. G. SPENCER, Shreveport, La. The fastener is designed for application to the bolt board of bolts of cloth or other fabric. When in place the end arms of the fastener conform to, and rest snugly against, the ends of the boards, while the side arms rest snugly against the sides of the boards, no matter what their thickness. At the ends of the side arms are hooks, or prongs, which bite into opposite faces of the bolt board.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**
MUNN & CO.

Marine Iron Works. Chicago. Catalogue free.

Inquiry No. 2288.—For manufacturers of ocean wave swings.

Motor Vehicles. Duryea Power Co., Reading, Pa.

Inquiry No. 2289.—For manufacturers of merry-go-rounds.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 2290.—For makers of screw-cutting foot power lathes.

WATER WHEELS. Alcott & Co., Mt. Holly, N. J.

Inquiry No. 2291.—For manufacturers of small balloons.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 2292.—For whitewood or cucumber-wood.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 15, Montpelier, Vt.

Inquiry No. 2293.—For veneer-cutting machinery for making scale boards.

Rigs that Run. Hydrocarbon system. Write St. Louis Motor Carriage Co., St. Louis, Mo.

Inquiry No. 2294.—For makers of peanut slot machines.

For metal articles, any kind, made any shape, write us. Metal Stamping Company, Niagara Falls, N. Y.

Inquiry No. 2295.—For makers of pickles, sauces, etc.

Are you looking for anything in bent woodwork? Write Tucker Bicycle Woodwork Co., Urbana, Ohio.

Inquiry No. 2296.—For the makers of "Our Pride" handmill.

We develop inventions through their several stages, manufacturing for the market. Amstutz Osborn Co., Cleveland, O.

Inquiry No. 2297.—For dealers in small malleable iron castings.

Machine Work of every description. Jobbing and repairing. The Garvin Machine Co., 149 Varick, cor. Spring Sts., N. Y.

Inquiry No. 2298.—For manufacturers of barrel staves.

Manufacturers of patent articles, dies, stamping tools, light machinery. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 2299.—For manufacturers of acetylene gas plants for residences.

Patents developed and manufactured, dies, special tools, metal stamping and screw machine work. Metal Novelty Works Co., 43-47 S. Canal St., Chicago.

Inquiry No. 2300.—For address of the publishers of the "Acetylene Gas Journal."

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 2301.—For wholesale dealers in white gutta percha.

The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $4. Munn & Co., publishers, 361 Broadway, N. Y.

Inquiry No. 2302.—For machines, run by power, for making wire fencing.

WANTED.—Mechanical engineer, one acquainted with fertilizer and oleo plants preferred. Permanent position to party able to satisfy. Adress "Fertilizer," Box 773, New York.

Inquiry No. 2303.—For dealers in toy novelties.

Wanted—Revolutionary Documents, Autograph Letters, Journals, Prints, Washington Portraits, Early American Illustrated Magazines. Correspondence Solicited. Address C. A. M. Box 773, New York.

Inquiry No. 2304.—For makers of small dynamos and storage cells.

Inquiry No. 2305.—For dealers in stereoscopes and views.

Inquiry No. 2306.—For dealers in gasogenes and apparatus for making carbonated waters.

Inquiry No. 2307.—For makers of cocoanut shredding machines.

Inquiry No. 2308.—For a cokes breakmachine for steam or hand power.

Inquiry No. 2309.—For machines for mixing condition powders.

Inquiry No. 2310.—For makers of cedar ice cream tubs.

Inquiry No. 2311.—For a machine to be driven by a 5 horse power portable gasoline engine for making tank dams.

Inquiry No. 2312.—For a lawn mower that will cut outside the wheels.

Inquiry No. 2313.—For a high-grade balanced slide valve engine of 300 h. p.

Inquiry No. 2314.—For dealers in electric heating apparatus.

Inquiry No. 2315.—For a manufacturing plant for mohair goods.

Inquiry No. 2316.—For machinery for making potatoes fine enough for starch-making purposes.

Inquiry No. 2317.—For an outfit for tinning small articles.

Inquiry No. 2318.—For parties to make paper novelties, such as teaspoons with hollow handle.

Inquiry No. 2319.—For manufacturers of "Locomotive Turn Table."

Inquiry No. 2320.—For dealers in grinding magnesite.

Inquiry No. 2321.—For dealers in rollers for rolling molten glass into sheets.

Inquiry No. 2322.—For wholesale dealers in small carved Mexican canes.

Inquiry No. 2323.—For a boiler 4 or 6 h. p. adapted for launch, quick steamer, etc.

Inquiry No. 2324.—For an alcohol motor for launch about 4 h. p.

Inquiry No. 2325.—For machinery for making pulp out of waste straw and paper to be made into boards.

Inquiry No. 2326.—For makers of blackboard erasers.

Inquiry No. 2327.—For makers of wire-bending machinery.

Inquiry No. 2328.—For dealers in second-hand lathes, Brown & Sharpe's preferred.

Inquiry No. 2329.—For machines for making muslin or silk.

Inquiry No. 2330.—For parties to make small mirrors with narrow metal rims 2½ in. in diameter.

Inquiry No. 2331.—For a belt 6 in. wide and 42 in. long of strips or leather ⅜ in. wide, known as a "laminated belt."

Inquiry No. 2332.—For parties to make a porcelain igniter of special design.

Inquiry No. 2333.—For manufacturers of mail chutes.

Inquiry No. 2334.—For manufacturers of clothes-pin machinery.

Inquiry No. 2335.—For manufacturers of small woodworking machinery.

Inquiry No. 2336.—For manufacturers of lawn mower grinders.

Inquiry No. 2337.—For manufacturers of small frictional machines.

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March 18, 1902,

AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.

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Aerator, milk, G. W. Look 695,570
Air brake, P. W. Vogt 695,771
Air ship, C. M. Richmond 695,589
Air, vacuum or steam brakes, hose-coupling for, Roberts & Kestler 695,839
Aluminous ores, purifying, D. A. Penrakoff 695,762
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Ax head and handle therefor, R. H. Carter 695,909
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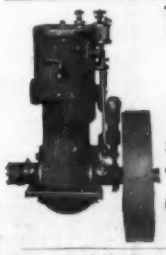

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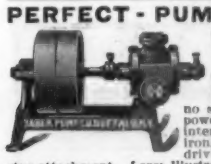

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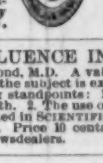

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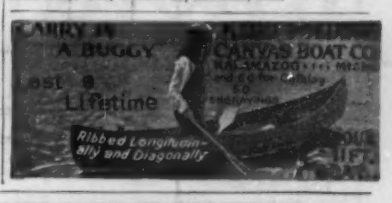

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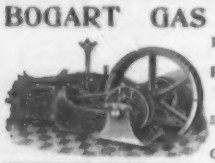

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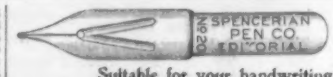

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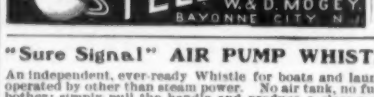

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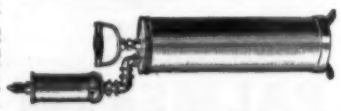

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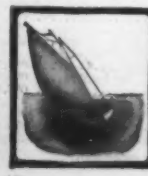

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(8571) I. D. B. asks: 1. What is the cause of static electricity gathering on the radiators, door knobs or any metal surface in the house, or if one person touch another it will cause a spark? A. The electricity in question is produced by the friction of the person's feet in moving about, and the spark results from induction when the person presents a hand to the door knob or to another person. The electricity opposite to that of the charged person is attracted from the earth, and jumps as a spark to meet and discharge the electricity of the charged person. At almost any time in cold weather anyone can produce a spark by rubbing the feet along a woolen carpet as he walks a few steps. Then hold a finger toward any object, and a spark may be thrown between the finger and the object. 2. Is there any way to get rid of it? A. Avoid moving in such a way as above described. 3. Is it possible to make a magnet that will have a pull of from 3 to 5 pounds and a movement of about one inch, to be operated by a battery? If so, please give description, size wire, etc. A. Yes. The coil you will wind depends upon the current you will use. You can make a magnet of No. 14 to 16 cotton-covered copper wire 8 inches long and 4 inches in diameter, and with a good battery it will probably do what you ask for it.

(8572) W. H. asks: Is it best to use an electric current having a high amperage and a low voltage or a current having a high voltage and low amperage in telephoning through barbed wire fences? A. The transmitter is connected through a battery to the primary of the induction coil, the secondary of which is connected to the two wires of the line, if a metallic circuit is employed. If a ground return is used, the secondary is grounded, the other end of the secondary wire is attached to the line. This gives a voltage on the line much higher than in the transmitter.

(8573) H. C. C. writes: Query 8476 in the SCIENTIFIC AMERICAN reads something like this: "To force a spark through one inch of air requires 30,000 volts"; and yet the small wires of the secondary stand the enormous pressure without damage to the coil. But on using direct current the wire would be ruined in an instant. Please explain in Notes and Queries. A. The statement is quite correct. It requires about 30,000 volts to force a spark through one inch of dry air. In the windings of a secondary there are no points where turns with anywhere near such a difference of potential between them are brought within an inch of each other. Then too shellac and other insulators which are better than air are used between the coils. A wire carrying a direct current of 30,000 volts would not be destroyed if it had resistance enough to reduce the current to so small a fraction of an ampere as is generated in the secondary of an induction coil. The higher the voltage the smaller the wire used to carry a given amount of electrical energy. 2. Please tell me where I can obtain the Fuller battery. A. Write to an advertiser who deals in general electrical goods or in physical or chemical apparatus. They will know where the article can be obtained. It is probably to be found in the catalogues of every supply house in New York city. We presume there are dealers in your own city who can get it for you.

(8574) F. G. L. Asks: Will you kindly inform me if there is in the market of today an electric motor that has no revolving armature? A. There is no motor which has not a revolving part. It may not be called an armature. In the induction motor it is sometimes called the rotor, and the stationary part is called the stator. This is because the parts do not resemble those of the direct current machines. The rotary part may be only an iron disk.

(8575) A. R. asks: In "Fuller" batteries what fluid is used in connection with the zinc, and what with the carbon? A. Water may be used upon the zinc. Upon the carbon pour a solution made as follows: Water, one gallon; sulphuric acid, one quart; bichromate of potash, one pound. Pour the acid into the water slowly with constant stirring, and while hot stir in the bichromate.

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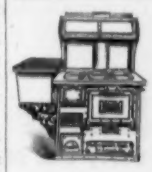

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